THE ECONOMICS OF CONTROLLED ATMOSPHERE

STORAGE AND TRANSPORT FOR

NECTARINES, APPLES AND KIWIFRUIT

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PREFACE

Technical change affecting agriculture and horticulture is not limited to production techniques and systems. Change in the harvesting, packaging, storage and transport activities, or the physical distribution processes, are important, not only to hold down costs, but also to enhance the presentation and quality of the final consumer product.

Controlled atmosphere transport and storage is a technology that could have important implications for New Zealand horticultural producers. This is so particularly with respect to the exploitation of new markets and the likelihood of increasingly severe constraints on air cargo space out of New Zealand. This study undertaken in the AERU is timely because of the interest in horticulture over the past few years and the increased production expected in the next decade.

This report gives an economic evaluation of controlled atmosphere storage and transport for three horticultural products: nectarines, apples and kiwifruit. The research has been undertaken for, and has been financially supported by, the Department of Scientific and Industrial Research. The evaluation has been stimulated by the Horticulture and Processing Division of DSIR who have been studying the technology of controlled atmosphere storage for a number of years.

P. D. Chudleigh
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SUMMARY

This report discusses the implications of extending conventional coolstorage technology to include manipulation of the storage atmosphere. Controlled atmosphere (CA) storage has recently become the focus of research in New Zealand, aimed at both evaluating the response of particular fruit to different atmospheres, and developing the technical capability to create and maintain the desired atmospheres.

The discussion in this report identifies and evaluates the potential economic benefits available from the introduction of CA technology for nectarines, apples and kiwifruit. The fruit have different markets and marketing systems and hence the potential role of CA technology varies.

Nectarines

CA sea transport of nectarines has the potential of reducing transport costs to existing markets (where air transport is presently used). In addition, the development of markets currently unprofitable because of high air transport costs, and currently inaccessible by sea transport (because transit times exceed nectarine storage life),is possible using CA technology. Extending the storage life of nectarines is also recognised as having the potential for taking greater advantage of end of season price premiums, when nectarine supplies arriving in export markets are declining.

The research indicates that the introduction of CA technology into the nectarine marketing system is likely to increase export returns significantly. In the future, with substantially higher volumes of fruit becoming available for export, the introduction of a technology that allows nectarines to be seafreighted to all markets will be critical in determining the actual volume of nectarines exported.

While CA storage will allow higher volumes of fruit to attract end of season premiums (intra-season price averaging), and allow the differing sensitivity of export markets to quantity fluctuations to be exploited (inter-market price averaging), the volumes of fruit involved in such practices is small compared to the volumes associated with the development of sea transport under CA conditions. This conclusion is supported by an analysis based on the forecasted export volume for 1990. The presence of a sea transport option increases export volume by over 230 per cent from that possible without the option of using sea transport.

In terms of the ability to absorb the expected higher storage and transport costs associated with CA technology, the estimated net revenue gains from utilising the CA technology indicate that significant increases in seafreight costs could be absorbed without making the introduction of CA technology unprofitable.

Apples

The ability to store and transport apples in a controlled atmosphere (CA) environment for sale in export markets is presently of little advantage to New Zealand. This is due largely to the fact that New Zealand's export season already overlaps with domestic apple harvests in importing countries. Even on export markets where domestic production is an unimportant factor, competition

from alternative Southern Hemisphere suppliers determines the profitability of New Zealand's exports rather than the period over which New Zealand exports can be marketed. It is, however, recognised that if fruit sold during the existing export season were stored and transported under CA conditions, then the fruit marketed would be of comparatively better quality than fruit held under conventional conditions. Nevertheless the ability to capture these quality improvements in terms of higher prices is not automatic, and depends on the overall competitive position of New Zealand supplies on the market.

More immediate and certain gains from CA technology can be obtained on the domestic market for fresh apples. Fresh apple sales are spread over a twelve month period from a harvest that is largely concluded after five months. Hence, fruit quality in later months (i.e. near to the start of the next season) is markedly lower than fruit sold during the current season or immediately after it.

This research indicates that the net revenue gains per carton from the CA storage of apples are likely to be positive for both the New Zealand Apple and Pear Marketing Board (NZAPMB) and gate sellers.

Given the NZAPMB's more aggressive approach to competing with gate sellers, its current CA storage capability, and the growth in apple imports from North America, it is unlikely that much requirement is seen for additional CA capacity for the domestic market. The already high per capita consumption of fresh apples in New Zealand is another important reason for reaching this conclusion.

It is probable that gate sellers have more incentive to develop additional CA storage facilities than the Board. In the face of a more price competitive market during the traditional gate selling season, it seems reasonable to assume that incentive exists for gate sellers to extend their selling season. While probably not increasing overall sales significantly, this strategy would at least enable them to maintain their share of the fresh apple market, and increase their income at the same time. Growers in Auckland, Waikato and Canterbury have the greatest opportunity to take advantage of the benefits from CA stores, since they are close to large population centres, and distant from the NZAPMB's main supplying regions of Hawkes Bay and Nelson.

Kiwifruit

Given the storage life of kiwifruit under conventional coolstorage, it is apparent that all potential markets could be exploited utilising lower cost sea transportation. Also, the storage life of kiwifruit does not appear to restrict exporters from attaining their desired seasonal distribution of exports. The desired seasonal export distribution for kiwifruit has two peak selling periods. The first occurs during May and June, before domestic summer fruit supply in the Northern Hemisphere increases. The second peak occurs during September. New Zealand grown kiwifruit sold after September increasingly face competition from the Northern Hemisphere kiwifruit crop so that the commercial advantage to New Zealand exporters of extended kiwifruit storage life is unlikely to be great.

CA storage is likely to have its greatest impact on the period over which kiwifruit may be packed prior to export or long-term coolstorage. Currently, nearly all kiwifruit are graded and packed within 48 hours of harvest. Thus, the grading and packing operation must be completed within the six week harvest period. It is technically quite simple to extend the packing season to sixteen weeks utilising a carbon dioxide/air CA. As an over 600 per cent increase in kiwifruit production is expected between 1983 and 1990 the ability to extend the packing season will become important. If the six week period for grading and packing operations was maintained, considerable investment in appropriate grading and packing facilities would be required if the whole crop was to be handled. Any extension of the packing season could reduce the required investment considerably.

This research compared three feasible storage technologies that allow the packing season to be extended. The first two incorporate CA conditions in the coolstore, either by building a rigid CA coolstore, or by introducing flexible plastic 'tents' into conventional coolstores. Both of these technologies allow the packing season to be extended by ten weeks.

The third storage technology evaluated excluded the necessity of creating CA conditions. High-humidity by itself has been found responsible for generating a significant proportion of the period by which CA conditions extend the packing season. Specifically, in a high-humidity coolstore, the packing season could be extended by an additional four weeks, allowing a ten week packing period.

This research indicates that the total cost of investment in packing and coolstore facilities that must take place between 1983 and 1990 can be reduced significantly by extending the packing season. Compared to the $182.6m investment required to ensure a six week packing season is maintained, extension of the packing season by 10 weeks (to 16 weeks) utilising rigid CA bulk stores allows savings of $4.3 million to be made. Higher savings ($17 million) could be made by extending the packing season by only four weeks utilising the rigid CA technology.

Although the CA storage technology enables considerable savings in total investment to be made, even greater savings could be made by extending the packing season by only four weeks (to 10 weeks) using high-humidity bulk coolstorage. In comparison to the investment associated with a six week packing season, adopting the high-humidity storage option is estimated to reduce total investment costs by almost 16 per cent, or $28.5 million. Thus, while the use of CA storage conditions is technically possible and economically of some advantage, it is an economically inferior option in comparison to the lower cost high-humidity storage technology.

In concluding that the high-humidity storage technology is economically superior to the CA technology, it should be recognised that even more economical options could be developed to cope with projected increases in the kiwifruit crop. For example, it was assumed throughout this research that packhouses operate on a single shift, thirty day season. Clearly, double shifts and weekend work would allow much greater throughput in existing packhouse facilities, and would reduce the amount of additional packhouses required in the future. Of course, the demand for labour associated with this option may limit its introduction. However, by 1990, automatic packing may complement the existing automation of grading, so that the labour constraint may not be as severe.

CHAPTER 1

INTRODUCTION

The ability to store fresh horticultural products can make an important contribution to the profitability of New Zealand horticultural enterprises. For practically all types of fruit, the harvest period is spread over a maximum of three or four months of the year. Where storage is not possible, the fruit must be sold over the same period. For many products, the concentration of supply can result in depression of prices. Hence, an extension of the period over which fruit may be marketed can have the potential for improvements in market returns, higher sales volumes, or both, where market circumstances favour later season sales. For many products, the ability to extend their storage life and therefore their sea transport capability opens up the potential of Northern Hemisphere markets, which can have a ready demand for out of season fresh produce.

This report discusses the implications of extending the conventional coolstorage technology to include the manipulation of the storage atmosphere. Controlled atmosphere (CA) storage has recently become the focus of research in New Zealand, aimed at both evaluating the response of particular fruit to different atmospheres, and developing the technical capability to create and maintain the desired atmospheres.

The discussion in this report identifies and evaluates the potential economic benefits available from the introduction of CA technology for nectarines, apples and kiwifruit. The fruit have different markets and marketing systems and hence the potential role of CA technology varies. At present over 90 per cent of nectarine production is sold domestically, while over 90 per cent of kiwifruit production is exported. Of total fresh apple sales, 60 per cent are made to export markets and 40 per cent domestically.

Chapter 2 begins with a discussion of fruit maturity and post-harvest handling, the two most important factors influencing the final eating quality of fruit. The discussion then deals specifically with nectarines, apples and kiwifruit, emphasising the potential CA storage has for extending their storage life and improving fruit quality (over conventional storage), and the implications this has for the marketing system for each fruit. The marketing implications of CA technology identified in Chapter 2 for nectarines, apples and kiwifruit are then evaluated in Chapters 3, 4 and 5 respectively.

CHAPTER 2

STORAGE AND MARKETING IMPLICATIONS OF CONTROLLED ATMOSPHERES

2.1 Introduction

The objective of this chapter is to identify the implications of controlled atmosphere (CA) technology for the storage life of nectarines, apples, and kiwifruit, and the subsequent marketing implications.

Sections 2.2 and 2.3 of the chapter discuss the importance of fruit maturity and post-harvest handling in determining the final eating quality of fruit. Section 2.4 deals in turn with nectarines, apples, and kiwifruit, identifying in each case the potential place of CA technology in the particular marketing system.

2.2 Fruit Maturity and Eating Quality

As a fruit matures, a number of physiological changes occur. Jackson (1981) summarises these as:

1. Increasing sugar levels;
2. Increasing flavour;
3. Reduction in acidity;
4. Softening of fruit;
5. Changes in the respiration rate and
6. Changes in colour.

The precise time when a fruit may be classified as mature, i.e. ready for harvest, eating or storage, is a relative concept. For example, a fruit which is intended to have an optimum flavour and texture for eating directly after harvest will be harvested at a later stage of development than a fruit picked so that it will keep for the longest period in cool storage.

It is important, however, that the fruit be physiologically mature prior to harvest. The physiologically mature fruit contains the necessary nutrients, acid, and carbohydrate levels to ensure that the fruit can continue to ripen independently of the plant. During the ripening process, the eating quality of fruit is especially improved by the changing composition of its carbohydrates. Specifically, levels of simple sugars such as sucrose, glucose and fructose are built up as starch is broken down. The ripening process also involves a softening of the fruit as sugar levels increase.

The importance of physiological maturity can be illustrated from research undertaken with kiwifruit which are considered physiologically mature when their soluble solids (ss) content reaches 6.2 per cent. Harman (1981) reported taste panel scores for kiwifruit harvested at 5.0 per cent ss. The panel scored the fruit at -73, indicating dislike. Fruit at 6.25 per cent ss scored +4, indicating acceptability. Significantly, the fruit harvested in the experiment at the highest soluble solids content (8.5 per cent) found the greatest acceptability, scoring +54. Although acceptability clearly increases rapidly with increases in the harvested soluble solids content, fruit above 10 per cent ss are more liable to be contaminated with prematurely ripe fruit or fruit damaged by wind or frost which will reduce the storage life of the sound fruit. Therefore, harvesting begins at the minimum acceptable level of 6.2 per cent and is almost completed before fruit with a soluble solids content of over 10 per cent develop on the vine.

Similarly for apples, an acceptable level of physiological maturity can be attained before harvest without severly inhibiting the ability to handle the fruit.

Unlike apples and kiwifruit, nectarines contain little if any starch and the conversion of starch to sugar, which occurs post-harvest in apples and kiwifruit, does not occur during the ripening process for nectarines. Rather, nectarines continue to accumulate sugars from the tree until they are harvested. Thus, for nectarines (as for all stonefruit) the best eating quality is found in tree ripened fruit. However, in order to enable handling and transport facilities to operate without causing excessive fruit damage, harvesting must take place prior to the attainment of optimum ripeness.

2.3 Post-Harvest Handling and Eating Quality

2.3.1 Temperature Control

Apart from fruit maturity at harvest, the main influence on the final eating quality of fruit is the post-harvest handling. Usually, post-harvest handling involves a period of storage. Since the respiration rate of fruit largely determines the period for which it may be stored, storage methods used attempt to reduce the rate of respiration. The rate of respiration is largely determined by temperature; higher temperatures being associated with higher metabolic activity (respiration rate). Higher rates of respiration are associated with quicker fruit maturation. Hence, the basic feature of all storage methods is temperature control. Individual fruit types have different optimal temperatures for long-term storage. Nectarines and kiwifruit require 0°C, while apples require temperatures from -0.5°C to 3°C, depending on the variety. Long-term storage is enhanced if field heat is removed from fruit immediately following harvest. This pre-cooling prior to entry into cool stores can be undertaken by a variety of methods, including forced air, water, and vacuum cooling (see Lill and Read; 1981).

2.3.2 Humidity Control

The humidity in the cool-store is also an important influence on the period for which fruit may be stored. Relative humidities of up to 95 per cent are recommended in coolstores for bin-stored kiwifruit (Sale; 1981), and 80-90 per cent for nectarines (Hewett; 1981). If the humidity is lower than these levels, the fruit loses moisture to the atmosphere, causing loss of weight. The importance of these high humidities can be illustrated by the fact that a weight loss of only five per cent will cause fruit to appear wilted or shrivelled.

2.3.3 Atmospheric Control

Given optimum temperature and humidity control, additional gains in storage time can be obtained for some fruit through manipulating the gaseous content of the atmosphere in which it is stored. Atmospheric control is not a substitute for temperature and humidity control, but can be a useful complement.

The composition of normal air is 21 per cent oxygen, 0.03 per cent carbon dioxide and 78 per cent nitrogen, with the remaining almost one per cent made up of a combination of other gases. Since oxygen is required by the stored fruit for respiration and carbon dioxide (a product of respiration) inhibits respiration, atmospheric control is based on reducing the oxygen level and raising the carbon dioxide content of the storage atmosphere. By doing so, the respiration rate is reduced and therefore the time for the process of fruit maturation is extended.

(a) Modified Atmospheres (MA)

The various technologies used in manipulating the atmosphere can be classified according to whether the technique modifies or controls the atmosphere. Modified atmospheres (MA) are developed in two ways. Firstly, MA may be created by the fruit continuing to respire within a sealed environment. Usually, this is achieved by enclosing the fruit in plastic or cellophane wraps having differing permeability to oxygen and carbon dioxide. Oxygen is less able to enter the container, and carbon dioxide less able to leave. This type of MA is usually developed within individual packages of fruit (e.g. a tray of kiwifruit or nectarines), or within pallet loads of fruit by sealing the pallet with a plastic wrapping. This method of creating a MA does not necessarily result in an optimal MA and the atmosphere will vary over time. The main advantage of the plastic wrap method is that the low capital costs enable a MA to be developed for a range of quantities of fruit.

The second method used to develop a MA is by sealing the fruit in an air-tight enclosure, and then replacing the atmosphere with a pre-determined mixture of gases. The atmosphere is introduced on a 'one-shot' basis, and the atmosphere is not subsequently monitored and replenished as it is altered by the respiration activity of the stored fruit. This type of MA lends itself to pallet-size loads enclosed in plastic, as well as fruit transported in shipping containers. Hewett (1982) reports the commercial activities of the Transfresh Corporation in the United States, which utilises MA containers. From the report it is clear that the atmosphere created by the 'one-shot' technique is modified considerably during transit due not only to fruit respiration, but also to leaks from the container.

(b) Controlled Atmosphere (CA)

While MA and CA storage technologies both aim to achieve an optimum atmosphere for a particular fruit, only those technologies that incorporate accurate measurement of the atmosphere's gas composition, and an ability to adjust or replenish the atmosphere if it deviates significantly from its optimum mix, may be considered CA technologies.

Because of the technical difficulties in achieving and maintaining optimum CA conditions, the development of the technology has in the past been restricted to static coolstores. That is, the extension of the technology for fruit in transit is at a relatively infant stage of development. CA in static coolstores has been achieved by incorporating CA technology during construction of the store, or by erecting a gas-tight polythene 'tent' in an existing coolstore. While a specifically designed CA coolstore is probably a more effective means of achieving and maintaining a CA, its associated capital costs are around 50 per cent higher than a conventional coolstore.

2.4 Storage Life and Market Opportunities for Nectarines, Apples and Kiwifruit

2.4.1 Nectarines

(a) Storage Life

For maximum conventional storage life, it is usually recommended that nectarines be harvested at a flesh pressure of 6-8kg[1] (E. Hewett, pers. comm.). With air temperature maintained at 0°C and a relative humidity of 95 per cent, nectarines can be stored for up to three weeks. At the end of three weeks, the flesh pressure will have declined to around 3-5kg. The shelf life of fruit following such storage is usually around five days (at an ambient temperature of 20°C), after which the flesh pressure will have been reduced to 1-2kg, a level that will ensure good eating quality.

Attempts to store nectarines beyond three weeks risk the occurrence of chilling injury, a physiological disorder resulting in discolouring of the nectarine's flesh, and a dry, mealy texture. Such fruit, though externally still appealing, are unmarketable because of their extremely poor eating quality.

Research aimed at overcoming the chilling injury phenomenon has been concentrated in two areas (Lill, pers. comm.; Hewett, pers. comm.). Firstly, intermittent warming of stored fruit has been found to extend storage life from three weeks up to six weeks. If fruit is warmed to 20°C for two days every two weeks, chilling injury is avoided and acceptable eating quality is maintained. The second area of research has attempted to utilise controlled atmosphere technology in extending storage life. Lill (pers. comm.) successfully stored nectarines from the 1981/82 season for six weeks in an atmosphere containing five per cent oxygen and 15 per cent carbon dioxide. However, the benefit from a controlled atmosphere was not repeated in a trial using fruit from the 1982/83 season. Hence, evidence that CA increases the potential storage time for nectarines is inconclusive. It may be that a combination of intermittent warming and CA will prove to be the most effective means of increasing the storage life of nectarines. Up to eight weeks storage life may be obtained in this way.

(b) Marketing Implications

The main reason for the emphasis of research on extending the storage life of nectarines can be found in the desire to:

(i) Take advantage of end of season premiums when nectarine supplies are declining,

(ii) reduce the cost of transporting nectarines to existing export markets by using sea instead of air transport, and

(iii) to develop markets currently unprofitable because of high air transport costs, and currently inaccessible by sea transport because transit times exceed storage life.

The ability to take commercial advantage of the extension of storage life to six or eight weeks will depend on whether the storage technology developed is restricted to rigid (land based) coolstores or whether it will include flexible coolstores (i.e. sea based shipping containers). The fact that nectarines require intermittent warming presents special problems in developing shipping containers capable of both cooling and warming produce. In the absence of such

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[1] Using 7.9 mm plunger in appropriate Penetrometer.

containers, only markets with sea transport transit times of around 10 days will be accessible. In this case, the fruit would be warmed prior to packing in containers, maintained cool during transit to market, then warmed on arrival. Given that current shipping schedules are not designed to suit the stonefruit harvest season, and that fruit must be harvested once optimum maturity for long-term storage is reached, it may be necessary to hold fruit in coolstore (or in a CA container) for some time awaiting the sailing of a particular ship.

Chapter 3 of this report analyses in quantitative terms the marketing implications of extending the storage life of nectarines.

2.4.2 Apples

(a) Storage Life

In a well ventilated storage shed, apples may be stored for up to two months. Coolstores managed with optimal temperature control and relative humidity of 80-90 per cent enable at least an additional two months storage life, still leaving up to two weeks of shelf life available.

The apple harvest begins in January, peaks during March and April, and then declines to finish in May. Given this harvest distribution, the use of coolstorage enables fruit to be available at least until September.

Research has shown that the storage life of apples can be increased an additional two to three months if the apples are CA stored in an atmosphere of two per cent oxygen, and three per cent carbon dioxide. Thus, apples harvested in May can be marketed in December, enabling year-round marketing (Padfield, 1969).

The use of controlled atmosphere storage for apples has also been found to be an effective control against "bitter pit", a physiological disorder arising during storage ("bitter pit" is associated with a low calcium content in the apple). Cox's Orange, an important export variety for the European market, is especially susceptible to this disorder. In conventional coolstores up to 60 per cent of an orchardist's crop can show effects of "bitter pit", although on average only 20 per cent are affected.

(b) Marketing Implications - Export Market

Through the use of CA storage it is possible to market good quality apples over a twelve month season, instead of the nine month period from January to September using conventional storage techniques. The marketing implications of this potential differ according to whether the domestic or export market are considered.

In the 1981 season, 61 per cent of total fresh sales were made on the export market, the remaining 39 per cent being sold locally. Unlike nectarines, the storage life of apples enables all export markets to be reached using conventional refrigerated sea transport. Thus, the ability to CA store apples during transport is not justified on the basis of developing markets inaccessible because of an inability to seafreight produce. The marketing of apples on export markets also differs from nectarines in that considerable overlap exists between the period supplies imported from New Zealand are available and the period supplies from domestic producers are available. This overlap is especially important from July/August onwards, when imported stored New Zealand fruit comes into competition with fresh fruit harvested locally. Only in markets within South-East Asia, the Middle-East, the Caribbean and the

Pacific Islands is competition from domestic fruit minimal. However, these markets comprise less than 20 per cent of New Zealand's total apple export market at present. Also, New Zealand apples must compete on these markets, and on the important European and North American markets, with competitive Southern Hemisphere suppliers, namely, Australia, South America and South Africa. Thus, in terms of exploiting export markets, the additional storage life provided from CA storage is not an important factor. Indeed, on the North American and European markets, attempts to market fruit in the normal marketing season of domestic producers has led to demands for quantitative restrictions on imports of New Zealand produce after certain dates.

One potential advantage of CA storage of apples for export is recognised within the existing export season. Specifically, fruit stored under CA conditions will be of better quality than conventionally stored fruit marketed at the same time. This is especially true for the important Cox's Orange variety, which is susceptible to "bitter pit". However, since 1979, vacuum infiltration of Cox's Orange apples with calcium has eliminated the "bitter pit" occurrence in export fruit. Hence CA conditions are only an alternative to an already successful treatment.

At present, the incentive to utilise CA technology for the storage and transport of export apples is negligible. In the future, as export markets become more competitive, the maintenance of New Zealand's position as a supplier of superior quality fruit may necessitate the introduction of CA technology. The use of CA will therefore seek to maintain rather than improve market returns.

(c) Marketing Implications - Local Market

The use of CA storage for the apples sold on the domestic market has greatest potential in ensuring a year round supply of apples is available at an acceptable level of quality. With conventional cool storage practices, acceptable quality can only be guaranteed up until September, although domestic sales continue until the end of November. However, since some of the fruit sold in the latter months of the season is already CA stored, not all fruit sold is of a comparatively lower quality. CA also enables sales of locally grown fruit during December complementing the present policy of importing North American fruit over the summer period.

Chapter 4 of this report discusses more fully the local market implications of CA storage for apples. The discussion also presents a quantitative analysis of the marketing implications.

2.4.3 Kiwifruit

(a) Storage Life

Kiwifruit will store adequately for from four to five months in a conventional coolstore at an air temperature of 0°C. Under high relative humidity (95 per cent) and CA conditions, the storage life of kiwifruit may be extended to six and up to eight months. Storing kiwifruit under CA conditions is not a substitute but rather an extension of optimum temperature and humidity control. For bin stored fruit, a relative humidity of 95 per cent is recommended, while for packed fruit only an 85 per cent relative humidity is required in the store itself, since the polythene liners in storage cases raise the actual relative humidity around the fruit.

Research reported by Harris and McDonald (1980), Harman and Hewett (1981) McDonald and Harman (1982) and Harman and McDonald (1983), shows that CA conditions of two per cent oxygen and five per cent carbon dioxide produce the best storage results. Although atmospheres with carbon dioxide between six and ten per cent in air allow similar gains in storage longevity to be attained, fruit quality (i.e. flavour, texture) was better over the long term with the lower carbon dioxide and oxygen concentrations.

From a technical viewpoint, although the five per cent carbon dioxide, two per cent oxygen CA gives optimum storage results, the atmosphere is difficult to attain and maintain. Since the natural carbon dioxide production from the stored kiwifruit will tend to raise the carbon dioxide level in the atmosphere, CA stores must have sensors that detect small changes in the atmosphere, and equipment that will 'scrub' the excess carbon dioxide. Under the higher carbon dioxide/air storage atmospheres, the production of carbon dioxide by the fruit is more easily controlled by venting the store, since the oxygen introduced is not critical in maintaining the atmosphere, as it would be if air was vented into the low carbon dioxide/oxygen atmosphere.

Figure 1 depicts changes in the flesh pressure (or firmness) of tray-packed kiwifruit stored under three atmospheres: normal air, high carbon dioxide (eight per cent) in air, and the optimum atmosphere for long-term storage (five per cent carbon dioxide, two per cent oxygen). Figure 1 may be taken as indicating the difference between the various storage regimes, although the actual position of the curves drawn on the graph will shift both vertically and horizontally between seasons.

The curves in Figure 1 show that kiwifruit soften rapidly during the first four to eight weeks storage. After this, the rate of softening declines. Figure 1 also reveals that after long term storage, the vertical gap between the three curves is in absolute terms quite small compared to the gap existing early in storage. For example, after four weeks, the difference between fruit stored in normal air and fruit stored in the carbon dioxide/oxygen mixture is over 3 kg flesh pressure, but after 28 weeks the difference is just over 0.5 kg. It is significant that after 28 weeks the air stored fruit still has a flesh pressure above the minimum export standard of 1 kg.

It is important to note that although the curves drawn in Figure 1 attribute all the gain in flesh pressure above the "normal air control" to the CA conditions, the CA conditions in themselves are not entirely responsible for the gains reported. Specifically, a by-product of creating the gas tight CA environment is a high relative humidity of around 95 per cent. If these high humidity conditions are achieved in a normal air store, much of the gains shown by Figure 1 are captured.

(b) <u>Marketing Implications - Export Market</u>

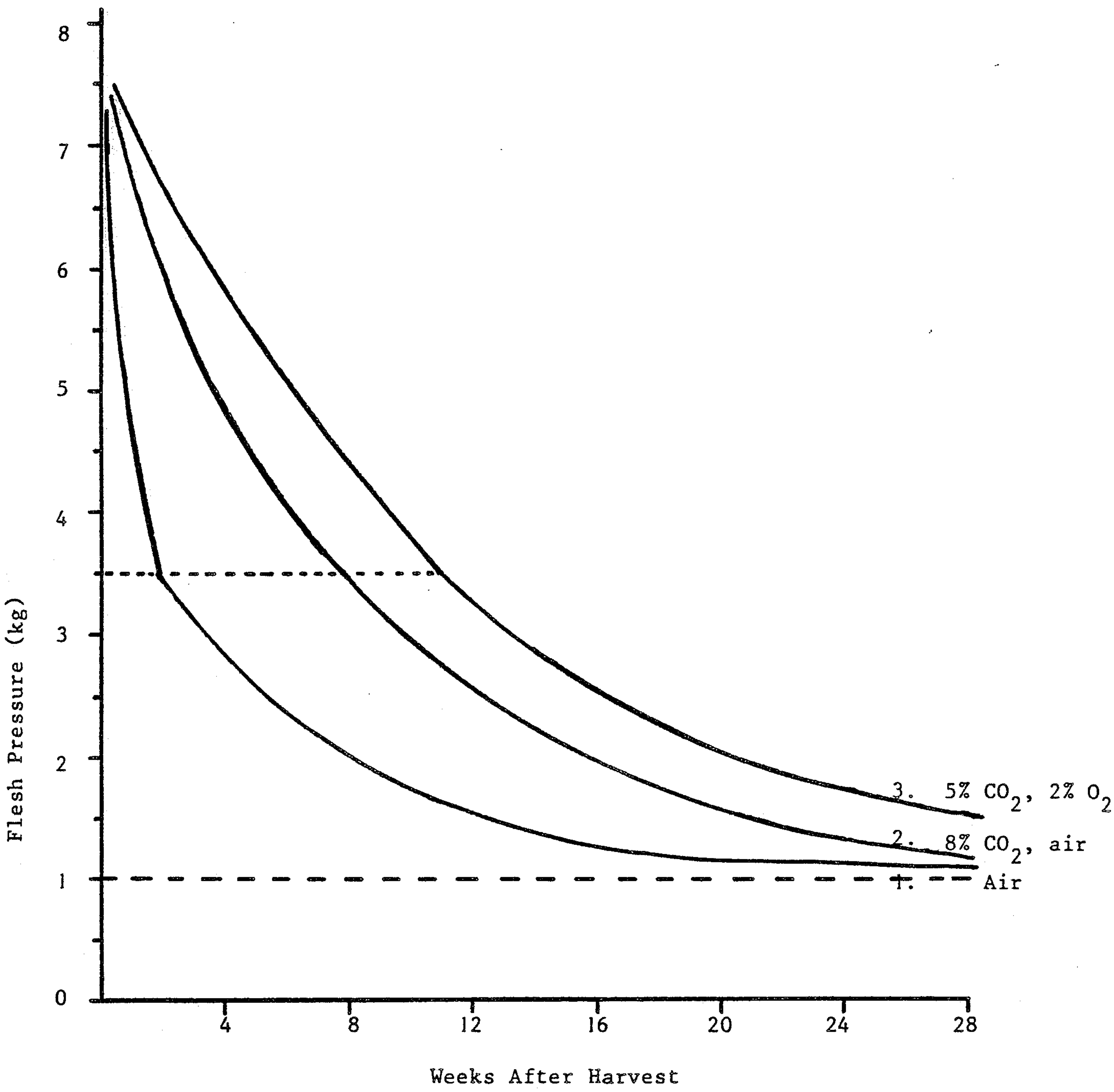
The kiwifruit harvest usually begins in early May and continues for six weeks ending during the middle of June. The marketing of the fruit is spread over the seven month period ending November.

Like apples, the storage life of kiwifruit under conventional coolstorage does not inhibit the use of lower cost sea transport. Thus, all potential markets can be exploited utilising sea transport.

FIGURE 1

Kiwifruit Flesh Pressure After Harvest

(Air temperature 0°C, Tray-Packed fruit)



Source: Based on Harman and Hewett (1981)

The storage life of kiwifruit does not appear to be creating problems in terms of the seasonal distribution of exports either. The emphasis in kiwifruit marketing has always been to have the peak selling period during May and June, before fruit in the Northern Hemisphere is harvested. For example, during the 1982 season, 35 per cent of total kiwifruit exports left New Zealand during the two month period ending June. During the next two months, coinciding with the Northern Hemisphere summer fruit harvest (i.e. peaches, apricots, plums, apples), just over 25 per cent of total kiwifruit exports left New Zealand. After the peak of the Northern summer fruit harvest, exports of New Zealand kiwifruit increased during September, amounting to 15 per cent of total exports in that month alone. From October onwards, exports began to drop off as supplies of kiwifruit in coolstores were exhausted.

October also coincides with the start of the Northern Hemisphere kiwifruit harvest. Already in the North American market, supplies of domestically grown fruit have risen to levels that almost exclude entirely imports from New Zealand after October given the present market size (Orchardist; February 1983, p.26). Domestic kiwifruit production in this and other markets will become an increasingly important factor in determining the profitability of New Zealand exports from October onwards. Competition from domestic producers is not only an important factor for late season exports from New Zealand. On the Australian market, New Zealand exports compete with domestically grown kiwifruit from May until the end of July.

Given the present seasonal exporting strategy adopted by kiwifruit exporters, and the growth in the Northern Hemisphere kiwifruit crop, it would seem that the potential for extending the storage life of kiwifruit using CA conditions is of limited commercial advantage. Figure 1 also reveals that conventional storage practices already allow fruit harvested in June to be marketed up to seven months later. Of course, fruit stored for that length of time will be inferior in terms of eating quality to CA stored fruit, but it is unlikely market returns would recognise that difference, especially if 'fresher' domestic production is available.

(c) Marketing Implications - Packing Operations

CA storage is likely to have its greatest impact on the period during which kiwifruit may be packed prior to export or long term coolstorage. Kiwifruit must be graded and packed while still relatively hard. If the fruit have softened significantly, bruising will occur, reducing the quality of the fruit and shortening its storage life considerably. The minimum flesh pressure suggested for the packing operation is 3.5 kg.

From Figure 1, it can be seen that while kiwifruit may be harvested at 7.5 kg flesh pressure, after two weeks under normal air storage the flesh pressure is reduced to 3.5 kg. In a CA of eight per cent carbon dioxide in air, an additional six weeks is available before the 3.5 kg flesh pressure is reached (Figure 1). A further three weeks is gained using the carbon dioxide/oxygen mixture (Figure 1). However, recent experiments indicate that kiwifruit may be stored in the carbon dioxide in air mixture for a ten week period before the minimum 3.5 kg flesh pressure is reached (Murray Gough, BOP Fruitpackers Ltd, pers. comm.).

Currently, nearly all kiwifruit are held in coolstores within 48 hours of harvest and all are packed within one week. Thus, the grading and packing operation is largely completed within the six week harvest period. In 1982, 4.7 million trays of kiwifruit were exported but by 1990, over 70 million trays are expected to be produced in New Zealand. If the present grading and packing operation is maintained, this production must be packed over a six week period. This will require considerable investment in appropriate grading and packing facilities, which will only be utilised over the harvest period.

An alternative to this situation would be to bulk store kiwifruit in CA conditions, extending the packing season from six weeks to twelve weeks or up to sixteen weeks (M. Gough, pers. comm.) using the eight per cent carbon dioxide in air mixture. Given that the sixteen week packing season could be gained from the carbon dioxide/air mixture which is technically simple to maintain, it is likely that this would be more readily adopted commercially than the carbon dioxide/oxygen mixture.

The analysis of the place CA storage has in extending the packing season for kiwifruit is presented in Chapter 5. Since a number of alternative responses to the growth in kiwifruit production and subsequent pressure on grading, packing and storage facilities are possible, the discussion in Chapter 5 is based on a comparison between a number of storage options. Specifically, these options include:

1. Increasing packing and storage facilities so that a six week season is maintained,

2. Extending the packing season to sixteen weeks utilising rigid CA coolstores,

3. Extending the packing season to sixteen weeks utilising flexible CA 'tents' in conventional coolstores, and

4. Extending the packing season to ten weeks utilising conventional coolstores with supplementary humidification.

CHAPTER 3

NECTARINE MARKETING AND CONTROLLED ATMOSPHERE STORAGE AND TRANSPORT

3.1 Introduction

In Section 2.4.1, the implications of controlled atmosphere (CA) technology for nectarine export marketing were discussed. CA sea transport of nectarines was established as a possibility with the potential to reduce transport costs to existing markets (where air transport is presently used). In addition, the development of markets currently unprofitable because of high air transport costs, and currently inaccessable by sea transport (because transit times exceed nectarine storage life) was suggested as possible using CA technology. Extending the storage life of nectarines was also recognised as having the potential for taking greater advantage of end of season price premiums, when nectarine supplies arriving in export markets were declining.

The discussion in Section 3.2 provides a description of nectarine production trends in New Zealand. Section 3.3 and 3.4 contain a review of nectarine marketing on domestic and export markets respectively. A quantitative analysis of the benefits of extended storage is reported in Section 3.5.

A summary of the chapter is presented in Section 3.6.

3.2 Production

3.2.1 National Production

In 1981, total nectarine production was 5,124 tonnes. Almost all of this was for consumption as fresh fruit with only 36 tonnes being sent to processors. Table 1 shows that production in 1981 was 27 per cent higher than in 1980, continuing the rapid production increases seen since 1975. Production in 1983 is provisionally estimated as 6,031 tonnes, 12 per cent higher than the harvest produced in 1982. In the period 1975 to 1981, total nectarine tree numbers doubled, although the area covered by these trees only increased by 38 per cent. This reflects the increased intensity of tree plantings, rising from an average of 376 trees per hectare in 1975 to 552 trees per hectare in 1981. More intensive nectarine tree densities allows the period from orchard establishment to full production to be shortened from over six years to around two to three years after planting. Yield per hectare under the intensive production system does not increase at the same rate as tree intensity. With the rapid introduction of new nectarine varieties, the intensive production system also reduces the time taken to change varieties in an orchard (see Wilton; 1981a and 1981b). The 1978 fruitgrowing survey (ASD; 1981) showed that 62 nectarine varieties were planted in commercial orchards, nearly double the number of varieties reported in the 1968 survey.

TABLE 1

Nectarine Production

	Tree Numbers	Area	Prodn.	Growers	Trees Per ha.	Prodn. Per ha.	Hectares Per Grower
	(000)	(ha.)	(tonnes)	(No.)	(No.)	(t/ha.)	(ha.)
1953	27	-	-	451	-	-	-
1958	32	-	-	-	-	-	-
1968	41	-	-	-	-	-	-
1973	95	262	-	-	363	-	-
1975	131	348	2203	-	376	6.3	-
1976	140	369	2637	-	379	7.1	-
1977	145	349	2697	-	415	7.7	-
1978	153	364	2485	667	420	6.8	0.55
1979	162	380	3795	681	426	10.0	0.56
1980	184	408	4047	697	451	9.9	0.59
1981	265	480	5124	739	552	10.7	0.65
1982	-	-	5370P	-	-	-	-
1983	-	-	6031P	-	-	-	-

- not available
P provisional

Source: Advisory Services Division (ASD) Crop Forecasts, MAF, Wellington. MAF (1983).
New Zealand Horticulture Statistics 1983, MAF Media Services, MAF, Wellington.
ASD (1981) Fruit Growing Survey 1978.

Table 1 shows that in 1981, the average grower had 0.65 hectares of nectarine trees planted, which, assuming a 10.7 tonnes/hectare harvest, would have produced just under seven tonnes of nectarines over the season. These statistics reflect the fragmented nature of the nectarine industry. Typically, growers producing nectarines also produce other stonefruit, pipfruit, berryfruit or sub-tropicals such as kiwifruit. Also, growers seldom plant only one variety of nectarine, but have a number of varieties that ripen at different times over the season, spreading labour requirements and reducing capital requirements for packing and storage facilities. In recent years, however, greater specialisation in production is becoming evident, with reports of some nectarine orchards of over 20 hectares (Turner, 1983). These more specialised orchards are typically orientated towards producing for export markets.

3.2.2 Regional Distribution of Production

Table 2 summarises regional production statistics for 1978 and the period 1980-1983. For each of the five years of data presented, North Island production accounts for over two-thirds of the national total. Hawkes Bay is the most important region within the North Island. In association with the Poverty Bay and Wairarapa regions, Hawkes Bay accounts for over 80 per cent of North Island production. In 1983, production was over 150 per cent greater than in 1978. Rapid production growth in other North Island regions is centred in the Waikato/Bay of Plenty region. In 1983 production in this region was over 500 per cent higher than 1978, making its share of total North Island production rise from 7 per cent to 15 per cent.

TABLE 2

Regional Nectarine Production

Region	Production				
	1978	1980	1981	1982P	1983P
			(tonnes)		
Northland	7	7	13	15	24
Auckland	218	344	219	224	158
Waikato, Bay of Plenty	109	247	280	355	635
Poverty Bay, Hawkes Bay, Wairarapa	1295	2027	3044	3060	3306
Wanganui, Manawatu, Taranaki, Horowhenua	4	28	34	n.a.	46
North Island	1633	2653	3590	3654	4169
Nelson	170	91	172	230	163
Marlborough	28	37	42	50	107
Canterbury	22	84	86	151	142
South Canterbury	4	8	6		
Upper South Island	224	220	306	431	412
Alexandra	549	1050	1109	n.a.	n.a.
Roxburgh	79	124	118	n.a.	n.a.
Dunedin, North Otago	nil	nil	1	n.a.	n.a.
Lower South Island	628	1174	1228	1285	1450
South Island	852	1394	1534	1716	1862
New Zealand	2485	4047	5124	5370	6031

P provisional

Source:

1978 Based on survey data in ASD (1981)

1980-1981 ASD (various) Annual Crop Statistics, MAF, Wellington

1982-1983 ASD (various) Crop Forecasts, MAF, Wellington.

Production in the top half of the South Island is spread evenly between Nelson, Marlborough and Canterbury. In 1983 Nelson produced 40 per cent of the upper South Island's production, with Marlborough and Canterbury contributing 26 and 34 per cent respectively. Since 1978, production in Canterbury has grown by almost 450 per cent, and in Marlborough growth in production of just under 300 per cent has been recorded.

The lower half of the South Island produces over three quarters of South Island nectarines, 90 per cent of these being grown around Alexandra. Production in the Alexandra region more than doubled in the three year period up to 1981, while around Roxburgh production increased by 50 per cent. Over the next two years (1981-1983) provisional total production levels in Central and North Otago have increased by another 18 per cent indicating a slowing down of the earlier growth rate. However, recent indications are that a new expansion phase will begin around 1985, as heavy plantings of nectarine trees in 1982 and 1983 become productive. Of the 100,000 stonefruit trees planted in Central Otago over this two year period (1982-83), two-thirds were thought to be nectarines (Anon., 1983).

3.2.3 Future Production

While production statistics are a good indication of a region's importance to present and future nectarine production in New Zealand, the influence of adverse environmental conditions in particular years tends to mask longer term changes in the underlying productive base. Thus, it is important in gauging potential production to consider the area devoted to nectarine production. This is likely to be a better indicator of future production than trends in tree numbers, given the more intensive production systems being developed (see Section 3.2.1).

Table 3 summarises nectarine area statistics for the regional groupings given in Table 2. The increasing dominance of North Island production is evidenced by the change from 54 to 46 per cent North:South balance in 1973 to the 1981 balance of 66 to 34 per cent. Within the South Island, the nectarine area in the top half of the South Island has grown from 8 to 12 per cent of the national aggregate over the 1973 to 1981 period. The changing distribution of production is further evidenced by calculating the annual growth rates in nectarine areas indicated by Table 3. Table 4 provides data on nectarine area and production growth rates which indicates that the North Island annual growth rate almost doubled between the periods 1973-78 and 1978-81. The growth rate in the upper regions of the South Island has slowed down from 16.5 per cent per annum to 6.5 per cent, while the lower South Island has turned positive after five years of stagnation up to 1978. Table 4 also shows that the per annum increase in production over the period 1978-1981 was at least double that of the area growth rate. This is largely due to more intensive plantings of trees.

If the 1978-1981 average growth rate in national nectarine area (10.5 per cent per annum) is applied to the 1981 production level, then by 1990, nectarine production would be 12,810 tonnes, almost 150 per cent higher than the 1981 level of 5,124 tonnes. The fact that production tends to increase faster than area indicates a much higher level of nectarine production in 1990. However, forecasting using a constant growth rate implies (in absolute terms) successively greater area increases for each year up to 1990. This would almost certainly over-estimate the probable nectarine crop in 1990 (unless the growth rate actually increases). Given the tendency to under-estimate because of changes in per hectare production, and the tendency to over-estimate because a constant growth rate was assumed, the 1990 production estimate of 12,810 tonnes may be a reasonable one.

Whereas Table 4 shows that growth rates up to 1981 have differed markedly between regions, it is apparent from recent production data (1982-83) (see Table 2) that the growth rate in the South Island has probably increased while that for the North Island has decreased. It may therefore be reasonable to assume that the national growth rate used to estimate production in 1990 can be applied equally to all regions. Thus the 1990 production estimate can be regionally allocated according to the 1981 production distribution. Table 5 summarises the estimate for each region. It should be noted that such production estimates imply returns achieved are both acceptable to current growers and high enough to attract new producers to the industry.

TABLE 3

Nectarine Areas

Region	1973	1978	1981	Area 1973	1978	1981
		(ha)			(%)	
North Island	142	205	309	54	59	66
Upper South Island	22	47	58	8	13	12
Lower South Island	98	97	105	38	28	22
Total	262	349	472	100	100	100

Source: 1973, 1978 ASD (1981) Fruitgrowing Survey 1978.
1981 ASD (1981) Annual Crop Statistics.

TABLE 4

Growth Rates in Nectarine Areas and P oduction

	Area [a] 1973-1978	1978-1981	Production[b] 1978-1981
		(%/annum)	
North Island	7.5	14.7	30.0
Upper South Island	16.5	6.5	11.0
Lower South Island	-0.2	2.6	21.6
New Zealand	5.8	10.5	27.2

a based on data in Table 3
b based on data in Table 2

TABLE 5

1990 Nectarine Production Forecast

Region	1981	1990	Distribution
	(tonnes)		(per cent)
North Island	3590	8967	70
Upper South Island	306	769	6
Lower South Island	1228	3084	24
New Zealand	5124	12810	100

3.3 Domestic Marketing

3.3.1 Sales Volume

Table 6 shows that at least 91 per cent of nectarine production over the period 1975 to 1982 has been consumed on the domestic fresh fruit market. Fruit destined for processors in recent years is less than one per cent of total production, while the remaining five to eight per cent of production has been exported in fresh form.

TABLE 6

Nectarine Markets: Domestic and Export

	Volume				Percentage		
	Total	Domestic		Export	Domestic		Export
		Fresh	Processed	Fresh	Fresh	Processed	Fresh
		(tonnes)				(%)	
1975	2203	2098	87	18	95	4	1
1976	2637	2405	84	148	91	3	6
1977	2697	2469	60	168	92	2	6
1978	2485	2352	17	116	94	1	5
1979	3795	3440	134	221	91	4	5
1980	4047	3751	42	254	93	1	6
1981	5124	4839	36	249	94	1	5
1982P	5370	4884	30	456	91	1	8
1983P	6031	5543	30	458	92	-	8

P provisional MAF (1983) New Zealand Horticulture Statistics 1983.

Source: MAF Media Services.
NZDS (various) Export Statistics, Government Printer, Wellington.

Given the rapid increase in nectarine production and the relatively constant proportion of fruit consumed domestically, total domestic consumption of fresh nectarines has risen by over 160 per cent (equivalent to 3,445 tonnes) since 1975. In per capita terms, nectarine consumption has risen from 0.68 kg/capita in 1975 to 1.76kg/capita in 1983.

3.3.2 Auction Prices

Table 7 summarises auction prices for nectarines in the Christchurch market over three seasons.

The range of prices reported in Table 7 reflects differences in the count (number of nectarines per tray) of the nectarines sold. The lower the count, the larger the nectarine and generally, the higher the price obtained. For export, a 25 to 28 count is preferred. Table 7 shows that the domestic prices in Christchurch relate to 30-48 count nectarines, that is, relatively small nectarines in relation to those preferred for export. In fact, the 30-48 count fruit is not all uniformly sized. Because of the difference between prices paid for low and high count fruit, growers tend to pack fruit of uneven count for the domestic market. While premium prices for larger fruit are foregone, the penalties that would be incurred for a line of uniformly small fruit are avoided. To a large extent, this consideration is an important reason for the low proportion of total nectarine production actually exported. The potential for overall increased returns for uniformly graded fruit has not been realised by the majority of growers. As long as the local market remains attractive in comparison to the export market, the volume of uniformly small fruit being sold domestically will remain limited. However, as much of the future production from recent tree plantings is expected to be destined for export, the local market will be affected by increasing volumes of smaller fruit. It is recognised by growers and auctioneers alike that it is the volume of high count (i.e. small) fruit that tends to set the overall price level on the auction floor. Increased volumes of small fruit will therefore reduce overall local market price levels.

TABLE 7

Nectarine Prices - Christchurch Market

Month	1980/81	Season 1981/82	1982/83
		($/tray, 30-48 count):[a]	
December	7.50		14.00-19.00
January	1.20-1.60	2.50-8.10	15.00-19.00
February	2.10-2.90	2.80-7.50	
March	2.10-2.90	4.50-6.50	
April	2.10-2.90		

[a] tray = 4.5 kg gross, 3.7 kg net. Count = no. of nectarines per tray.

Source: Diprose (various)

3.3.3 Grower returns

Buchanan (1982) estimates grower returns were 30 per cent of the total auction market price. Table 8 reproduces Buchanan's analysis for a grower selling all fruit produced on the local market, and a grower selling only non-export fruit on the local market. The analysis clearly indicates the difference in prices received and grower returns achieved where only the smaller, non-export grade fruit is sold on the local market. However, the total grower return can only be assessed when the export return is added to the local market return for the smaller fruit.

TABLE 8

Net Grower Returns for Central Otago Nectarines
Sold on the Domestic Market (Christchurch)

(1981/82 Season)

	All Fruit Sold on Domestic Market (mixed sizes)				Non-Export Fruit sold on Domestic Market (> 25 to 28 count)			
			(cents/ tray)	(%)			(cents/ tray)	(%)
Market Average (Fruit value)			328				250	
Container Charge			43				43	
Total Tray Value			371	(100)			293	(100)
Less Commission (10%)	37				29			
Promotion Levy	6				6			
Telegram (share of charge for pallet, i.e. 125 trays)	3		46	(12)	3		38	(13)
			325	(88)			255	(87)
Per Tray Costs								
Less Materials								
Polystyrene tray	95				95			
Plix tray	17.5				17.5			
Lid	26				26			
Strapping and Tape	1				1			
Packing	30				30			
Wrapping	2.8	172.3			2.8	172.3		
Freight (to Christchurch)								
Orchard/Rail	14				14			
Rail	19				19			
Rail/Market	11	44	216	(58)	11	44	216	(74)
Net Return			109	(30)			39	(13)

Source: Buchanan (1982).

3.4 Export Marketing

3.4.1 Introduction

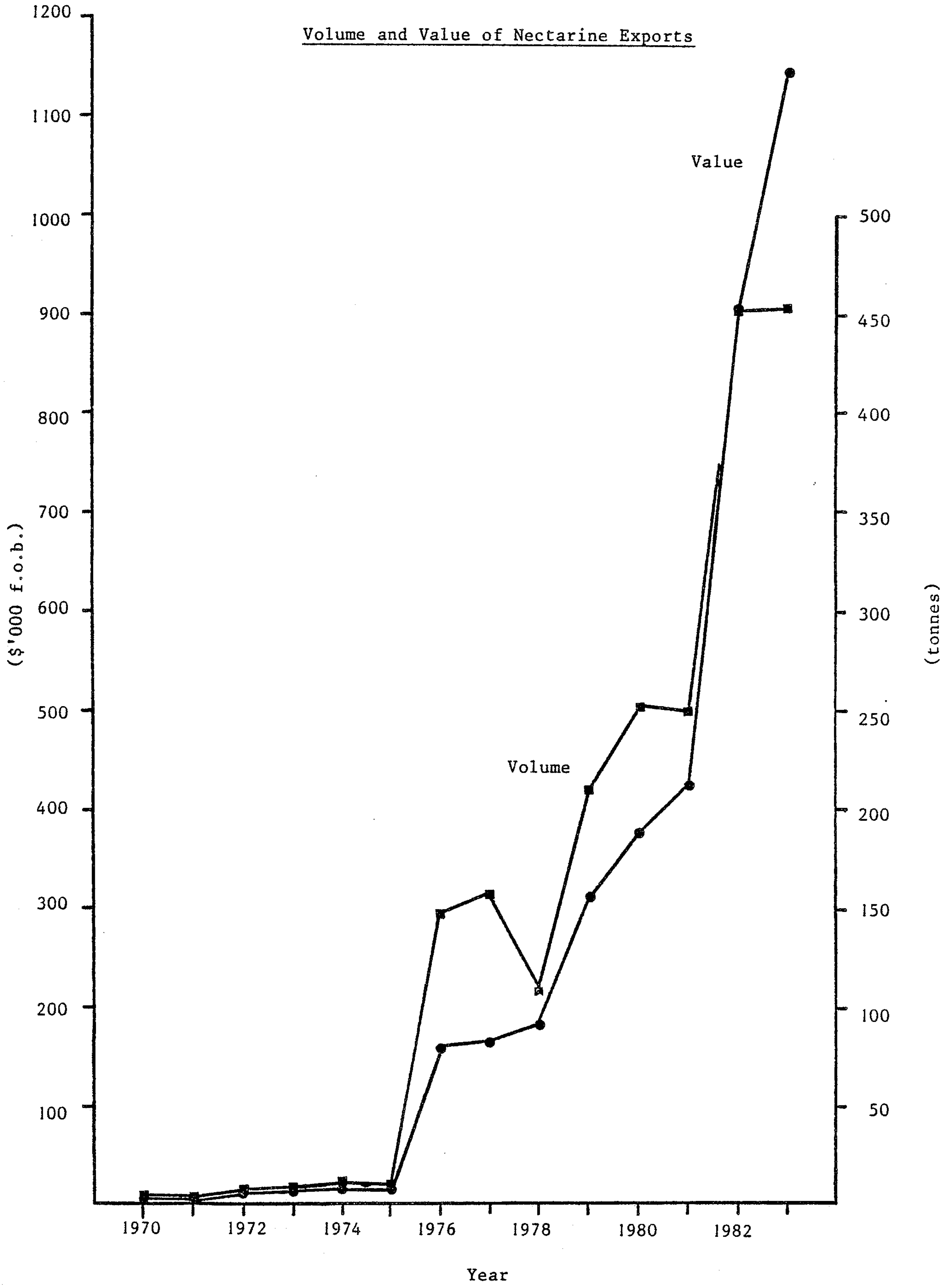
During the 1983 harvest season, 458 tonnes of nectarines were exported, at a total f.o.b. valuation of $1,147,072. As Figure 2 portrays, the 1983 season continued the almost exponential growth in nectarine exports seen since 1975.

3.4.2 Export Packout

Nectarine exports now account for eight per cent of total nectarine

FIGURE 2

Volume and Value of Nectarine Exports



production, compared to one per cent before 1975. The reasons for the comparatively low export packout were discussed in Section 3.3, but can be summarised as the buoyant domestic market for nectarines, and the fact that most growers prefer not to pack-out their highest quality fruit for export because of the effect this has on the domestic value of residual fruit. This mainly applies to the large number of growers with small nectarine areas. Larger growers tend to be more export orientated, and grade out between 30 and 40 per cent of their crop for export. In recent years, a small but increasing number of growers have been producing nectarines specifically for the export market, grading out up to 80 per cent of their harvest for export. Given the dependence of packing out percentages on environmental conditions, these growers may only achieve a 60 per cent export packout on average.

The consolidation of export nectarine production through the development of specialist export growers has obvious efficiency implications in the assembly and transport of export fruit. Also, it becomes possible for individual growers to invest in precooling and coolstore facilities and therefore exert greater control over both the quality and timing of sendings of product to markets.

3.4.3 Grower Returns from Export Fruit

Section 3.3.3 reported Buchanan's (1982) breakdown of the return a grower receives for selling fruit on the domestic market. Using a domestic auction floor price of $3.71 per tray, in 1982 it was shown that the grower's net return was $1.09 per tray. The analysis presented in Table 9 undertakes a similar analysis for fruit sold on the export market. Buchanan's analysis assumed the grower would sell to an exporter at the packhouse. However, since a major proportion of growers sell on consignment, the analysis shown in Table 9 reflects this. The distinction makes little difference to the growers' final net return.

Clearly the attractiveness to growers of nectarine exporting is apparent from the much greater net returns available, especially for late season nectarines which attract a premium. Of course, having assumed an export packout of 60 per cent, the 40 per cent of fruit not exported would receive a considerable discount on the local market. However, Buchanan (1982) shows conclusively that the gains from higher value export fruit far outweigh these discounts. Using the returns given in Table 8 for non-export fruit for 40 per cent of the crop (39 cents/tray) and an average export product return of 600 cents/tray (from Table 9) for the remaining 60 per cent of the crop, an overall average return of 375 cents/tray can be calculated. This must be considered to be no more than an indication of the return available but compares with a local market grower return of 109 cents/tray (Table 8) where all fruit is sold on the domestic market.

TABLE 9

Net Grower Returns for Central Otago Nectarines Exported (1982)

	Month Exported			
	February		March	
	(cents per tray)			
F.O.B. value[a]		692		1003
Less Commission	69		100	
Telegram	3	72	3	103
		620		900
Per Tray Costs				
Less Export Research Levy		10		10
Less Additional Marginal Costs per Tray Incurred in Producing Export Fruit (assume 60% packout)	28		28	
Less Materials	80		80	
Less Freight (to Christchurch Airport)	44	152	44	152
Net Return		458		738

a based on average unit values on all markets during February and March 1982.

Source: Based on Buchanan (1982)

3.4.4 Export Markets

(a) Overview

Of the forty countries to which nectarines have been exported since 1970, Australia is now well established as the most important market. In 1983, 91 per cent of the nectarines exported were directed to Australia. Australia's dominance is a relatively recent development, with 1976 being the first year when significant sales volumes were achieved. The growing importance of Australia has been matched by the decline of both the Pacific Islands and North America. While the decline of the Pacific Islands is much less evident when viewed in terms of absolute tonnage, the decline of North America has been dramatic; from a high export volume of 93 tonnes to the USA in 1979, to only 11 tonnes in 1983 and exports to Canada declined from 12 tonnes of nectarines in 1976 to nil by 1983.

Asia has been a small but steady market for nectarines, the principal markets being Hong Kong and Singapore.

Apart from the period from 1976 to 1979, European markets have been insignificant export destinations for New Zealand nectarines. Germany and France were the most important markets within Europe, while the United Kingdom imported almost 12 tonnes in 1976 (the only year of exports to the UK).

Apart from Australia, the Middle-East is the only other market showing growth. Almost 13 tonnes in total were sent to Bahrain, Kuwait, Saudi Arabia and the United Arab Emirates during the 1983 season, compared to half a tonne in 1977.

(b) Australia

Substantial nectarine exports to Australia began in 1976 (Table 10). Unit values have been maintained in real terms in spite of the increase in exported quantities. To some extent this is the result of a gradual decline in the value of the New Zealand dollar against the Australian dollar.

TABLE 10

Nectarine Exports to Australia

	Volume		Unit Value Actual	Unit Value Real[a]
	(tonnes)	(% change) from previous years	(NZ$f.o.b./tray)[b]	
1976	19	-	3.00	8.00
1977	54	+184	2.44	5.53
1978	77	+ 43	3.26	6.48
1979	61	- 21	5.11	9.06
1980	140	+130	5.37	8.46
1981	169	+ 21	8.55	11.43
1982	362	+114	7.22	8.39
1983	415	- 15	9.25	9.25

[a] Deflated by CPI December 1982 = 1000

[b] approximately 270 trays per tonne.

Source: NZDS (various) Export Statistics, Government Printer, Wellington. NZDS pers. comm.

From the two years of available data presented in Table 11, it is apparent that the export volume distribution tends to follow the distribution of harvest in New Zealand. The majority of exports to Australia takes place in February with January and March of approximately equal importance. Unit values are highest in March, reaching $12.47 fob per tray in 1983.

Although nectarine exports in January are the lowest of any month, Table 11 shows that market returns are also around their lowest level. This can be attributed to the overlap of the Australian nectarine crop with the first New Zealand product entering the market. Table 12 presents a breakdown of the Australian nectarine harvest distribution. The Table shows that while the bulk of the Australian harvest occurs from November to January, supplies would still continue to enter the market during the time the New Zealand crop is marketed. The actual market prices in Australia during the 1982/83 season reflected the pattern of Australian production and New Zealand exports. When the first New Zealand fruit began arriving in mid-January, and the peak of Australian production had passed, wholesale prices were at a level of A$8 c.i.f. per tray. Prices then increased at a constant rate for the next two months, until by mid-March A$20 c.i.f. per tray was being paid for nectarines. As the volume and quality of New Zealand fruit declined towards the end of the season, wholesale prices fell to A$16 c.i.f. per tray.

In 1975, Australian nectarine production at 3,737 tonnes was almost 30 per cent below the peak of 5,235 tonnes reached in 1973. Since 1975 nectarine production, if it has followed the trend of all other stonefruit in Australia, will have declined slightly but in recent years become more stable. Indications are that Australian producers are yet to respond to the market opportunities being exploited by New Zealand nectarine growers.

Given New Zealand exports of 415 tonnes in 1983, New Zealand's overall market share in the nectarine market would be around 10 per cent, although on a monthly basis this share would be substantially higher from February onwards. The nectarine share of the overall summer and autumn fresh fruit market is quite small, identifying the capability of the Australian market to absorb much greater quantities of New Zealand fruit.

TABLE 11

Nectarine Exports to Australia - Seasonal Distribution

	1982		1983[a]	
	Percentage of Seasons Exports	Unit Value	Percentage of Seasons Exports	Unit Value
	(%)	(NZ$fob/tray)	(%)	(NZ$fob/tray)
January	16	6.99	22	7.70
February	64	6.92	50	8.10
March	19	8.36	28	12.47
April	1	10.03	-	-
Season	100	7.22	100	9.25

a Season to March

Source: NZDS pers. comm.

TABLE 12

Australian Nectarine Production (1975)[a] and Harvest Distribution

State	Harvest Period	Volume of Production	
		(tonnes)	(%)
New South Wales	November-April	1007	27
Victoria	December-March	820	22
Queensland	November-February	623	17
South Australia	December-March	958	26
Western Australia	December-February	300	8
Tasmania	January-February	29	-
Australia	November-April	3737	100

a Production in later years not available from published sources.

\- less than 1.

Source: Commonwealth Bureau of Census and Statistics (1970) Rural Industries 1969-70 Bulletin No. 8, Canberra. Australian Yearbook (various).

(c) North America

Nectarine production in the United States, which is concentrated in California, was forecast to be 211,000 tonnes in 1981, maintaining the 8.2 per cent per annum production growth averaged since 1970 (see Table 13). Almost all nectarines produced are consumed in the fresh fruit market. The harvesting season for Californian nectarines begins in May and peaks during June and July, although significant quantities are still being harvested in August and September. Given this seasonal harvest pattern, New Zealand exports to the United States market do not face any competition from local supplies. In spite of this, a declining share of New Zealand nectarine exports have been sent to the North American market. In 1974 North America was a market for 72 per cent of New Zealand nectarine exports. By 1983 the proportion was two per cent. Table 14 shows that until 1979, North America's declining share of New Zealand nectarine exports was largely due to slower growth in comparison with other countries, since actual tonnages were relatively stable or growing. After 1979, tonnages exported into both the United States and Canada developed downward trends. These trends can be largely explained by two factors: the lifting of Australian quarantine restrictions allowing New Zealand nectarine exports to Australia since 1976, and the availability of cheaper alternative imports into North America from Chile.

TABLE 13

Nectarine Production in the United States
(1970-1981)

	Production ('000 tonnes)	Price Paid to Grower (US$/tonne)
1970	66	154
1971	70	157
1972	88	180
1973	87	259
1974	117	232
1975	112	279
1976	130	249
1977	158	208
1978	147	312
1979	174	200
1980	195	235
1981F	211	n.a.

F forecast

n.a. not available

Source: USDA Agricultural Statistics 1981, U.S., Government Printing Office, Washington.

TABLE 14

Nectarine Exports to North America

Year	Volume		Unit Values	
	U.S.A.	Canada	U.S.A.	Canada
	(tonnes)		(NZ$fob/tray)	
1970	4	nil	2.44	
1971	2	-	3.33	
1972	5	nil	1.89	
1973	4	2	2.74	3.03
1974	14	1	2.89	2.59
1975	8	nil	2.66	
1976	58	12	4.22	3.26
1977	57	1	3.92	4.18
1978	55	1	5.51	6.14
1979	93	4	5.25	5.66
1980	87	3	5.59	5.70
1981	55	-	6.18	5.11
1982	68	-	7.25	6.40
1983	11	nil	7.18	

\- less than one.

Source: NZDS (various) Export Statistics, Government Printer, Wellington.
NZDS pers. comm.

In 1983, the average f.o.b. value of a tray of nectarines exported to the United States was NZ$7.18, and to Australia NZ$9.25, producing a differential between the two markets of NZ$2.07 per tray. Clearly, the price differential encourages diversion of supply away from the more distant and less profitable market. Even when prices peaked in the United States market during mid March at US$16 c.i.f. per tray wholesale, the Australian market was paying A$20 c.i.f. per tray.

The second factor causing the loss of the United States nectarine market is the emergence of the Chilean nectarine industry. Agriculture Canada (1982) reports that in 1980, Chilean production of nectarines reached 43,000 tonnes. Production in 1984 and 1988 is forecast at 50,000 and 56,000 tonnes respectively. From the United States import statistics reported in Table 15, Chilean nectarines dominated fresh stone fruit imports in both 1980 and 1981. The nectarine exports to the USA of 4,100 tonnes in 1980 represented 9.5 per cent of Chilean production. If the same percentage of forecasted production in 1984 and 1988 is exported to the United States, Chilean nectarine exports in these two years will be 4,750 and 5,320 tonnes respectively. Table 15 also reveals that the average unit value of stonefruit imported from Chile into the United States was only 35 per cent of the unit value of the stonefruit originating from New Zealand. In 1982, the Chilean peso was devalued from 39 pesos to 66 pesos per US$, after being frozen at 39 pesos per US$ for three years. Chile's already large comparative advantage (mainly cheaper transport) versus New Zealand in supplying the United States market is therefore likely to have increased considerably. This additional advantage adds to the already considerable marketing advantages Chile has over New Zealand. Specifically, the Chilean nectarine harvest begins two weeks earlier than New Zealand and Chile can therefore airfreight fruit and obtain the USA early season premium. Also, closer proximity to the market enables main harvest nectarines from Chile to be seafreighted to market, allowing considerable freight savings versus New Zealand's air freight.

TABLE 15

United States Fresh Stonefruit Imports
(1980 and 1981, Calendar Years)

Category	Volume		Unit Value	
	1980	1981	1980	1981
	(000 tonnes)		(US$fob/tonne)	
Country				
Canada	0.6	-	503	2000
Chile	5.5	4.6	647	732
New Zealand	0.2	0.2	1884	2096
Other	-	0.1	1519	748
Stonefruit				
Peaches and Nectarines	4.1	3.2	668	732
Plums	1.6	1.5	729	782
Apricots	0.1	0.1	1672	2000
Cherries	0.7	0.1	577	2806
Total	6.4	4.9	684	783

Source: USDA (1981) U.S. Foreign Agricultural Trade Statistical Report, Calendar Year 1981.
Economic Research Service, USDA, Washington.

Chile is also the principal exporter of Southern Hemisphere nectarines to Canada. Canada imported 803 tonnes of nectarines from Chile in 1980, and 739 tonnes in 1981 (Commonwealth Secretariat; June 1982). In the same years New Zealand exported to Canada only 4 and 3 tonnes respectively.

Perhaps the greatest opportunities for New Zealand exports into North America occur very early in the season before the Chilean crop is harvested, and after the third week in March when Chilean supplies have dwindled. Table 16 clearly shows these two opportunities. The small amount of fruit that does enter the United States from New Zealand during December does attract a considerable premium. Over the same period airfreighted Chilean fruit in 1983 received US$16 c.i.f. per two tier tray[2]. In January and February the influence of Chilean seafreighted fruit entering the United States at US$8-10 c.i.f. per two tier tray is apparent in the unit values reported in Table 16 for higher quality New Zealand fruit. However, in comparison to the US$8-10 c.i.f. per two tier tray received by Chile, New Zealand nectarines are reported to have fetched US$12 c.i.f. per tray. This information is in line with the statistics presented in Table 15, showing Chilean fruit reaching only 35 per cent of the value of New Zealand stonefruit.

2 New Zealand sells single-tier tray units.

After Chilean fruit supplies decline throughout March, the average unit value received for New Zealand fruit rises markedly; by almost 80 per cent in 1983 to NZ$9.10 f.o.b. per tray. (The peak price received in March during 1983 is reported at US$16 c.i.f. per tray.) Thus, New Zealand stonefruit has a ready market in the United States from the end of March and during April, until early Californian nectarines become available in May. New Zealand's problem in exploiting this gap in supply is that the domestic harvest is almost complete by the end of March, so that supplies of export quality nectarines are unavailable.

TABLE 16

N.Z. Nectarine Exports to the United States - Seasonal Distribution

	1982		1983	
	Percentage of Seasons Exports	Unit Value	Percentage of Seasons Exports	Unit Value
	(%)	(NZ$fob/tray)	(%)	(NZ$fob/tray)
December	3	8.40	19	6.72
January	67	5.05	62	4.78
February	29	6.81	18	5.10
March	1	8.40	1	9.10
Season	100	5.08	100	5.24

Source: NZDS pers. comm.

(d) Pacific Islands

Of the sixteen Pacific Island nations to which New Zealand nectarines have been exported since 1970, only five have been consistent importers. French Polynesia and New Caledonia form the two major Pacific Island nectarine markets. Exports to New Caledonia peaked in 1977 at almost 16 tonnes, but since then have declined continuously until in 1983 only 5 tonnes were exported. French Polynesia on the other hand has been a more stable market taking 10 tonnes in 1983.

Nectarine exports to the Pacific Islands are largely undertaken by exporters supplying a range of grocery items to individual hotels and retail outlets. Fruit are included in the consignment of groceries but are not a major component of it. Because of the role fruit plays in the grocery trade, nectarine exports to the Pacific Islands are unlikely to rise greatly in the near future. Also, f.o.b. returns from these markets are usually no greater than the price setting market of Australia, so that the incentive to develop these markets does not exist. Table 17 shows that in 1983, the average price received for nectarines exported to Australia was greater than that received for the majority of exports to the Pacific Islands. The market price for end of season nectarines in Australia was higher than in any Pacific Island.

TABLE 17

Market Returns from the Pacific Islands (1983)

Country	Unit Value March	Unit Value Season
	(NZ$fob/tray)	
Australia	12.47	9.25
American Samoa	9.95	8.81
Cook Islands	17.39[a]	14.02
Fiji	9.62	8.66
French Polynesia	9.73	8.77
Nauru	10.66	10.36
New Caledonia	10.18	9.58
Niue	8.07[b]	8.07
Vanuatu	11.21	9.58
Wallis and Futuna Is.	8.88	8.25
Western Samoa	7.18	7.22

[a] February

[b] January

Source: NZDS pers. comm.

(e) Asia

Nectarine exports to Asia have never risen above four tonnes. Of the three tonnes exported to Asia in 1983, two-thirds went to Hong Kong, the remaining third to Singapore. Unlike the Pacific Islands, both of these markets provide returns equal to or greater than those obtainable in Australia, especially in January and February when Australian prices are at their lowest.

Dunphy (1981) identified a major difficulty in developing the Asian market, namely the need to supply small consignment lots to the market due to the lack of storage facilities for fruit when it arrives on the market. Importers require regular supplies arriving at frequent intervals. However, statistics gathered by Dunphy also reveal that prices in the Hong Kong and Singapore market peak during the New Zealand harvest period (December to March), when supplies are greatly reduced from their June to September peak. New Zealand's share of the December to March market in both Hong Kong and Singapore is small, so potentially large gains in market share could be attained. However, the data presented in Table 18 reveal that the landed cost of New Zealand stonefruit into both markets is the highest of any country, and so can represent a major barrier to increasing market share.

The market with the greatest potential in Asia is Japan, a market closed to all stonefruit imports (except cherries from the United States) due to the quarantine regulations. Japanese regulations prohibit stonefruit imports due to the suspected presence of codling moth eggs on the fruit. Research effort is being directed at developing a fumigation procedure acceptable to the Japanese which will allow imports to proceed. It is expected that such a procedure will be developed within the next five years. The United States, having developed an acceptable fumigation procedure for cherries, exported 2,550 tonnes of fresh cherries to Japan in 1981 at an f.o.b. value of US$2,060 per tonne, an increase of over 100 per cent from the 1978 level of 1,209 tonnes. These figures indicate the potential that the Japanese market holds for stonefruit.

TABLE 18

Hong Kong and Singapore - Stonefruit Imports (1979)

Category	Hong Kong Stonefruit		Singapore Peaches and Nectarines	
	Volume	Unit Value	Volume	Unit Value
	(tonnes)	HK$/kg	(tonnes)	S$/kg
Country of Origin				
United States	3494	0.77		
Israel			4	3.21
Taiwan	1082	2.50	7	2.38
South Korea	18	5.22		
Thailand	1819	4.50		
Japan	1370	6.01		
China	3124	1.29	19	1.11
South Africa	18	5.29		
Australia	194	9.10	206	1.11
New Zealand	4	16.33	1	4.41
Total	11123	4.70	257	1.54
Month				
January	267	5.08	8	3.25
February	38	8.61	19	2.68
March	70	7.56	7	4.71
April	49	1.27	172	0.65
May	330	3.38	-	0.90
June	1104	4.76	2	5.50
July	3137	5.01	4	4.75
August	3153	4.65	21	2.00
September	1198	2.99	7	8.29
October	348	2.92	15	2.13
November	748	6.54	-	1.00
December	666	5.44	2	5.50
Total	11123	4.70	257	1.54

\- less than one.

Source: Dunphy (1981)

(f) Europe

New Zealand exports to Europe began in 1976 at a level of 39 tonnes, and reached a peak in 1979 of 42 tonnes. Within Europe, Germany was historically the principal market, followed by France and the United Kingdom. After 1979, total exports to Europe have exceeded one tonne only once.

The reason for an increase then decline in exports to the European market can be explained partly by changes made to the export incentive scheme announced in the 1975 and 1979 budgets respectively and by the attractiveness of the Australian market. The increase in exports in 1976 followed the provision of export incentives in 1975 to nectarine exports. Changes in the export incentive scheme in 1979 reduced the benefit available to nectarine exporters from a maximum of approximately 40 per cent of f.o.b. value to 1.4 per cent (this being a result of the change to added-value as a basis for the incentive). The reduction in net exporter/grower returns for nectarine exports led to a reduction in exports to Europe. Better returns from exports to Australia were available and exports to that market increased sharply in 1980.

Future nectarine sales to Europe clearly depend on the ability to receive a grower return for New Zealand fruit on the European market comparable with that available from exports to Australia. This could be achieved through higher European prices or lower transport costs. In Europe, production of nectarines has increased dramatically in recent years. Table 19 shows that the four major producers are estimated to have harvested 253,000 tonnes in 1982, almost 50 per cent greater than the average production achieved during 1976 to 1981.

(g) Middle-East

Apart from Australia, the only other market with immediate growth prospects is the Middle-East. Exports until 1983 remained insignificant at around two to three tonnes per year, the majority of this going to Bahrain. In 1983, exports to Bahrain grew to over three tonnes, while Kuwait and Saudi Arabia entered the market taking seven and two tonnes respectively. Table 20 shows the seasonal pattern of export volumes and f.o.b. returns in the Middle-East during 1983. In comparison with returns in the Australian market, the Middle-East market returns are at least 15 per cent and up to 40 per cent higher (f.o.b. unit values) than Australia in every month. The returns during March in both Kuwait and Saudi Arabia were especially attractive, reaching around NZ$17 f.o.b. per tray.

An important key to the development of the Middle-East market has been the establishment of contacts within the countries. Australia has, because of its closer proximity to the market, become established as the major Southern Hemisphere supplier of imported fresh fruit. As a result, New Zealand exporters are creating arrangements with Australian agents with contacts in the Middle-East to sell New Zealand fruit, especially after Australian stonefruit supplies decline after January.

TABLE 19

Nectarine Production in Europe

Year	France	Greece	Country Italy	Spain	Total
			('000 tonnes)		
1976/81 average	51.1	6.2	100.9	11.2	169.4
1981	61.9	13.0	150.0	12.0	236.9
1982 (est.)	60.0	15.0	165.0	13.0	253.0

Source: Commonwealth Secretariat, Fruit and Tropical Products, June 1982.

TABLE 20

Nectarine Exports to the Middle-East (1983)

Month	Volume				Unit Value			
	Bahrain	Kuwait	Saudi Arabia	United Arab Emirates	Bahrain	Kuwait	Saudi Arabia	United Arab Emirates
	(kg)				(NZ$fob/tray)			
December	18	nil	nil	nil	13.17			
January	nil	440	840	nil		8.47	10.58	
February	900	3418	483	nil	7.22	9.36	10.58	
March	2408	3560	263	918	4.59	17.35	16.69	10.73
Season	3326	7418	1586	918	5.33	13.14	11.58	10.73

Source: NZDS pers. comm.

3.4.5 Transport

(a) Cost of Transport

Practically all nectarine exports are airfreighted. From statistics available for the 1982 export season, only five and a half out of the 456 tonnes exported were sent by sea. Over 90 per cent of the seafreighted nectarine exports were sent to the United States during January. The only other countries to which seafreighted nectarines were exported were American Samoa and Niue.

The cost of airfreight is almost without exception higher than seafreight, but given the perishability of nectarines, airfreight is usually the only transport system possible. Airfreight charges, (and insurance), once subtracted from the wholesale c.i.f. price available in an importing country, generate the f.o.b. price facing New Zealand exporters. Given the c.i.f. wholesale price in an importing country, the higher the airfreight cost, the lower the f.o.b. price New Zealand exporters must accept. With New Zealand's distance to the markets, airfreight charges are high, so that for sales to proceed, premium prices must be received for the fruit. Naturally, if sufficiently high prices cannot be gained, trade will not occur. The history of nectarine exports to Europe is a good illustration of this.

Table 21 develops unit values for the 1983 nectarine export season from f.o.b. in New Zealand currency to c.i.f. in the currency of the country of destination. As a common reference point, c.i.f. values in United States dollars were also calculated. Table 21 shows that freight rates to the United States and Asia are 80 per cent greater than to Australia, while freight charges to Europe and the Middle-East are almost 300 per cent greater. Freight rates to the Pacific Islands range up to 250 per cent greater than the Australian rate. Given these rates, freight charges contribute from 50 to 70 per cent of the total c.i.f. value of exports to Asia, Europe, the Pacific, and the Middle-East, whereas to Australia freight charges account for under 30 per cent of the c.i.f. export value. These figures highlight the attractiveness of the Australian market, which is able to absorb high volumes of fruit at c.i.f. prices which when converted to f.o.b. values, are attractive to growers. Using the analysis presented in Section 3.4.3 to calculate the growers return from export fruit, it can be shown that for fruit exported to Australia, the growers net return is over 50 per cent of the c.i.f. export value (the United States market returned 35 per cent of the c.i.f. value to growers, and Germany 31 per cent).

(b) Availability of Transport

In addition to the cost of transport being a restriction to higher volumes of nectarine exports in the future, the availability of airfreight space may also become a limit on export volume. This limit may occur because of two inter-related problems, viz. the availability of aircraft, and the competition for freight space from other goods.

TABLE 21

Nectarine Export Unit Values: From F.O.B. to C.I.F. (1983)

Country	Average f.o.b. over season[a]	Insurance[b]	Freight[c]	cif ($NZ)	cif Country of Destination[d] Local Currency	US Currency
		(NZ$/tray)			(per tray)	(US$cif/ tray)
Pacific Islands						
American Samoa	8.81	0.044	9.93	18.78		13.66
Cook Islands	14.02	0.070	3.78	17.87		13.00
Fiji	8.66	0.043	3.61	12.31	F$8.58	8.96
French Polynesia	8.77	0.044	5.03	13.84	Fr1245.5	10.07
Nauru	10.36	0.052	13.46	23.87		17.37
New Caledonia	9.58	0.048	4.17	13.80	Fr1241.9	10.04
Niue	8.07	0.040	9.93	18.04		13.13
Vanuatu	9.58	0.048	6.24	15.87		11.55
Wallis and Futuna	8.25	0.041	8.04	16.33		11.88
Western Samoa	7.22	0.036	4.56	11.82	T 12.02	8.60
Australia	9.25	0.046	3.70	13.00	A$9.70	9.46
Asia						
Brunei	12.73	0.064	8.30	21.09		15.35
Hong Kong	10.77	0.054	6.67	17.49	HK$84.12	12.73
Malaysia	9.99	0.050	4.99	15.03	MY$24.79	10.94
Singapore	9.14	0.046	6.88	16.07	SG$24.19	11.69
United States (W. Coast)	7.18	0.036	6.62	13.84	US$10.07	10.07
Europe						
Belgium	8.51	0.043	15.05	23.60	Fr860.2	17.17
Germany	10.36	0.052	14.32	24.73	DM43.18	17.99
United Kingdom	8.33	0.042	15.48	23.86	£11.22	17.36
Middle-East						
Bahrain	5.33	0.027	13.98	19.34		14.07
Kuwait	13.14	0.066	14.23	27.44		19.97
Saudi Arabia	11.58	0.058	13.98	25.62	R64.28	18.64
United Arab Emirates	10.73	0.054	13.80	24.58		17.88

Fr - Francs
T - Tala
R - Riyal

[a] From unit value over season, NZDS pers. comm.

[b] Assumed as 0.5 per cent of f.o.b. value.

[c] Freight based on "The Air Cargo Tariff" - Worldwide and North America, February 1983. Where available, freight rates based on special rates for food stuffs (description number 006). Although exports to some countries small, since nectarines exported with other foodstuffs, rate taken assumes 250 to 500 kg consignments. For Australia freight rate based on an LD5 (10 m³) container carrying 700 trays.

[d] Exchange rates quoted for 18 February 1983.

(i) Availability of Aircraft

The first problem relates to the availability of aircraft. International aircraft schedules reflect the demand for passenger travel rather than freight. The freight component of a passenger airline's business is usually marginally costed. Therefore the freight rates charged do not reflect the full cost of providing the service. The availability of airfreight space is therefore linked to the demand for passenger services. In 1983 forty-eight Boeing 747, twelve Boeing 737, and eleven DC10 aircraft per week fly out of Auckland International Airport. Six Boeing 747 SP and nine Boeing 747 (and one Boeing 737) fly out of Wellington and Christchurch airports respectively to international destinations. Forty-four or 70 per cent of the total Boeing 747 flights out of New Zealand land in Australia as their ultimate or intermediate destination (two 747's per week fly on to London). Four out of the ten DC10 flights also fly direct to Australia. The second most popular route is to Los Angeles via Nadi or Honolulu (or both). Ten Boeing 747 and three DC10 aircraft follow this route. Four Boeing 747 aircraft fly to Singapore per week (and from Singapore to Bahrain and Frankfurt, or to Abu Dhabi) while two DC10 and one Boeing 747 fly to Tokyo via Nadi. Two Boeing 747 fly to London via Papeete, and one to Hong Kong via Port Moresby. Noumea and Papeete are each served by one DC10 flight per week.

Most of the Boeing 737 flights were to Pacific Island airports, including Nadi, Apia, Suva, Rarotonga, Tonga, Noumea, Papeete, Nauru and Niue Island. BAC-111 aircraft are also used on these routes, hile Fokker Friendships are flown five times a week to Norfolk Island.

The number of flights and the type of aircraft used on any particular route creates an upper limit to the amount of freight that can be carried on that route. Once the freight has left New Zealand, transhipment opportunities widen the number of final destinations to which the cargo may be sent. However, the initial problem is still to be allocated space out of New Zealand. A Boeing 747 has a cargo hold with a capacity of just over 140 cubic metres. Twenty-five cubic metres of this is for bulk cargo; the remaining 115 cubic metres is for containers. Usually, 22 containers are carried; four LD7 (10 cubic metres each) and 18 LD1 (4.2 cubic metres each). Of the 18 LD1 containers, 13 are required for passenger baggage. Thus, of the 140 cubic metres of cargo hold, only 61 cubic metres (five LD1 and four LD7 containers) are available for perishable commodities. (The bulk cargo space is not used for perishables.) On flights which involve stopovers (for example, flights via Nadi and Honolulu to Los Angeles, Melbourne and Perth to London, Papeete to London, Port Moresby to Hong Kong, Nadi to Tokyo, and Singapore to Bahrain, Frankfurt and Abu Dhabi) the allocatable freight space would usually be reduced by another 20 cubic metres to allow freight to be picked up during the stop over.

It is apparent from available data and discussions with airline and exporter representatives, that little if any excess cargo capacity exists on aircraft leaving New Zealand over any part of the year. On average, the load factor for airfreight would appear to be between 80 and 90 per cent. Table 22 shows that 47,918 tonnes of freight were carried by aircraft out of New Zealand in 1982, nearly 70 per cent of this out of Auckland. The 22 per cent increase in total freight carried between 1980 and 1982 occurred in spite of declining aircraft movements. For example, total international aircraft movements out of Auckland airport in 1982 were five per cent lower than 1981, which itself was seven per cent lower than 1980. The additional freight carried in 1982 can be attributed to the introduction of specialised freighter aircraft on some routes. Air New Zealand used a DC-8 freighter aircraft between New Zealand, Australia and the United States, while Pan Am used Boeing 747 freighters to London (once per week), Chicago (once per week) and New York (twice per week). Due to their unprofitability, Pan Am ceased these freighter operations on 1 January 1983. The unprofitability of using specialised freighter aircraft out of New Zealand is due to the lack of backloading into New Zealand, so that the cost of a two-way flight must be borne by freight going one-way. Thus, freighter rates have to be at least double ordinary cargo rates to be profitable. Many exports, such as nectarines, cannot stand such costs and still provide reasonable returns to growers.

TABLE 22

Freight Carried on Scheduled International Aircraft Flights

Airport	Freight Leaving New Zealand				
	1978	1979	1980	1981	1982
			(tonnes)		
Auckland	26565	30343	33479	30754	37901
Wellington	1293	1237	1333	na	na
Christchurch	4222	4515	4383	na	na
Total	32080	36095	39195	na	47918

Source: 1978-80 NZDS (1982) Transport Statistics Report 1980-81.
1981-82 Auckland Regional Authority, pers. comm.
NZDS pers. comm.

(ii) Competition for freight space

Given the lack of excess freight capacity on passenger aircraft leaving New Zealand, and the high cost of using specialised freighter aircraft, competition for available space on passenger aircraft is high. Of the 47,918 tonnes airfreighted in 1982 (see Table 22), just under 50 per cent comprised food and live animals. The other 50 per cent was made up largely of chemicals, manufactured goods and machinery. In terms of unit values, the average f.o.b. unit value for the food and live animal airfreighted exports was NZ$5,020 per tonne, whereas the chemicals, manufactured goods and machinery ranged from NZ$8,436 to NZ$19,260 per tonne. Clearly, the higher the unit value the more a product is able to stand higher air freight charges, since they make up a smaller proportion of the product's total value. In the light of these figures, the average unit value for nectarines of NZ$2,500 f.o.b. per tonne is low, so that its ability to absorb higher freight charges is low compared to other products. Currently, foodstuffs and other commodities incur lower per unit freight charges than other goods. So-called "export incentive rates" for commodities airfreighted in containers between New Zealand and Australia are especially attractive, making airfreight cheaper than seafreight. However, the attractiveness of these airfreight rates is likely to be reduced as competition for space increases. Such was the case on the air route to Los Angeles, where the cost advantage of airfreight over seafreight for commodities was lost between 1982 and 1983. Thus, as competition for freight space increases, the need to offer discounts to attract lower valued commodities (such as nectarines) to fill available freight space diminishes.

3.5 Analysis of the Benefits of Extended Storage

3.5.1 Introduction

In estimating the benefits available from extending the storage life of nectarines, assumptions must be made regarding the technology employed, the degree to which the technology is utilised, and the sensitivity of individual markets to a different seasonal supply of nectarines. Because of these assumptions, the analysis presented below is not based on storage policies which are necessarily optimal. Rather, the analysis generates results suggesting the likely magnitude of benefits derived from a particular storage policy and the simplified economic environment in which it is applied. The effect on the analysis of altering particular assumptions is highlighted during the discussion.

The analysis of the benefits of extended storage for nectarines is under-taken for two seasons (1983 and 1990), and for two storage technologies (land based (static) storage, and land and sea based storage). The two seasons chosen allow the differences between the benefits from extended storage of present and future volumes of nectarines to be recognised. In presenting an analysis for two technologies, the uncertainty as to whether land and sea based storage will be possible is recognised. The analysis indicates whether the additional returns to both a land and sea based storage technology are significant. Whether the land and/or sea based storage technology is employed it is assumed in each case that the storage life of nectarines is six weeks. This would allow nectarines harvested in any particular month to be marketed during the following month, instead of the same month as is presently the case.

3.5.2 Analysis Based on 1983 Export Volume

(a) Introduction

Table 23 summarises the likely economic effects of extended storage given the marketing environment existing during the 1983 export season. Four major impacts of extending storage are recognised:

1. The effect of altering the monthly distribution of exports to individual markets and therefore the effect on the average price received in each month over the season. From Section 3.4.4 it is clear that end of season premiums are paid for nectarines exported to almost every market. For example, extended storage enables a proportion of fruit normally exported in February to be exported in March, attracting this end of season premium. Given the volumes of fruit exported in 1983 and the availability of airfreight, the intra-seasonal price effect of extended storage is not dependent on the technology developed.

2. The effect of altering the distribution of exports between markets. The potential for doing this arises through freight savings made in utilising sea rather than air freight. Given a c.i.f. price in a particular market, freight savings increase the f.o.b. return to New Zealand exporters, making the market more attractive. As additional supplies are diverted to the market, the price in the market where the supplies were originally destined should strengthen. For a land based extended storage system, only markets with shipping transit times of around twelve days offer

TABLE 23

Summary of Extended Storage Advantages - 1983 Export Volume

Storage Technology	Extended Storage Effects			
	Export Volume at Actual 1983 Level			Additional Exports Above Actual 1983 Level
	Intra-Seasonal Price Level	Inter-Market Price Level	Transport Costs	
A. Land Based Storage Only				
1. General Impact	Alter monthly distribution of exports to individual markets.	Alter distribution of exports to markets made more profitable by reduced transport costs.	Exports currently airfreighted but now able to be shipped.	(a) Additional supplies available at end of season when product supplies limit export volume. (b) Additional exports to markets made more profitable by reduced transport costs.
2. Markets Affected	All markets currently exported to.	U.S.A. Pacific Islands Australia	U.S.A. Pacific Islands	(a) All markets currently exported to. (b) USA, Pacific.
3. Export Crop Affected	Whole Season	Whole Season	Mid and late season.	(a) Late season. (b) Mid season.
B. Land and Sea Based Storage				
1. General Impact		As for Part A		
2. Markets Affected	All markets currently exported to.	All markets	All markets (except Australia)	All markets
3. Export Crop Affected	Whole season	Whole season	Mid and late season	Mid and late season

potential for the supply diversion strategy. Thus, Australia, the United States and the Pacific Islands would be of interest. When sea based extended storage is made available Europe, Asia and the Middle-East become accessible to sea-freighted supplies, so that supplies can be diverted to these markets, with the resultant positive effect on prices returned from other markets from which supplies have been diverted.

3. The effect on transport costs. Extended storage would allow the dependence on airfreight to be reduced. While early season fruit would still be airfreighted in order to attract early season premiums, mid and late season fruit could be seafreighted. Again, the type of technology available would determine the markets to which seafreight is a possibility.

4. The effect on export volume. Whereas the first three impacts of extended storage are related to the actual volume of exports in 1983, the existence of an extended storage technology would probably have led to higher export packouts over the 1983 season. During the peak of the export season, additional exports to markets made accessible through the use of seafreight would have been expected. This would tend to off-set the supply diversion strategy based on existing export volumes (discussed under point 2 above). End of season product availability for export is a limit to export volumes during March and April. Air freight charges are less of a barrier to trade during this part of the season when market prices are higher. Therefore extended land based storage would be expected to result in more fruit being available for export later in the season.

(b) Intra-Seasonal Price Averaging (Revenue Maximising) Effect

In estimating the effect extended storage would have had on the 1983 seasonal distribution of volumes and prices, assumptions must be made regarding the sensitivity of market prices to volume fluctuations over the season, the market share of New Zealand nectarines in each market over the season and the proportion of the export crop utilising the extended storage technology.

1. Australia

Richardson (1976) estimated a price elasticity of -0.599 for all fruit and vegetable purchases in Australia, that is, for a one per cent increase in fruit and vegetable prices, quantities purchased would decline by around 0.6 per cent. The inverse of the price elasticity approximates the price flexibility, in this case equal to 1.67. Thus, for a one per cent increase in the quantity supplied, the price received on the market would decline by 1.67 per cent. For nectarines, it is likely that the price elasticity increases rapidly during the period New Zealand supplies reach the market, since the supply of all summer fruits is declining and consumers desiring fresh summer fruit probably become more price conscious in the face of rising prices and dwindling supplies. Rising price elasticity over the season implies a declining price flexibility, allowing additional supplies to be marketed later in the season at less of a price discount.

For New Zealand, the price flexibility facing the nectarine export volume is also determined by the changing market share over the season. The higher the market share, the closer the price flexibility facing New Zealand exporters approaches the total market price flexibility. When New Zealand's exports make up only a small proportion of the total market, export volume can be increased with little price discount.

Table 24 summarises the price flexibility and market share assumptions made for the Australian market during the 1983 export season. The table shows that although New Zealand's market share increases over the season, the price flexibility it faces is initially stable and then declines as the overall market price flexibility declines.

TABLE 24

Estimated Price Flexibility Facing New Zealand Nectarine Exports in Australian Market - 1983

	Month			
	January	February	March	April
Market Price elasticity[a] (%)	0.60	1.20	2.40	4.80
Market Price flexibility[b] (%)	1.67	0.83	0.42	0.21
Market Share	20.00	40.00	60.00	90.00
Price Flexibility facing New Zealand[c] (%)	0.33	0.33	0.25	0.19
Return per tray (NZ$fob)	7.70	8.10	12.47	n.a.
Return per tray (NZ$cif)	11.44	11.84	16.23	n.a.

[a] Price elasticity: percentage by which quantity demanded will change for a one per cent change in price.

[b] Price flexibility: percentage by which price will change for a one per cent change in quantity supplied. Assume that price flexibility equals inverse of price elasticity.

[c] New Zealand's price flexibility equals market price flexibility times market share.

Given the seasonal trend in price flexibilities and market returns, total revenue from a market can be increased by diverting supply from lower to higher priced months, so long as the price flexibility in the higher priced month is equal to or less than the price flexibility in the lower priced month. This occurs because although higher volumes sold in the higher priced month reduce the price obtained in that month, the reduction does not offset the increased revenue obtained through greater volumes sold. Also, revenue obtained in the lower priced month is not reduced to the same extent as the volume decline, since prices rise. Table 24 shows that for the Australian market, total 1983 revenue could have been increased by transferring a proportion of export volumes in each month to the month following (given the assumptions made).

TABLE 25

Intra-Seasonal Price Averaging in Australian Market - 1983

	Month				Season
	January	February	March	April	
Actual 1983 Season's Prices and Volumes					
Volume (kg)	92524	205440	117115		415079
(trays)	25006	55524	31653		112183
Price per tray					
(NZ$cif)	11.44	11.84	16.23		12.99
(NZ$fob)	7.70	8.10	12.47		9.24
Total Revenue					
(NZ$fob)	192546	449744	394713		1037003
Estimated 1983 Season (10% storage in each month)					
Volume (trays)	25006	55524	31653		
	-2501	+2501			
		-5552	+5552		
			-3165	+3165	
	22505	52473	34040	3165	112183
Volume (% change)	-10.0	-5.5	+7.5		
Price Flexibility Facing New Zealand	0.33	0.33	0.25		
Price (% change cif)	+3.30	+1.82	-1.88		
(NZ$cif)	11.82	12.06	15.92	19.10[a]	13.38
(NZ$fob)	8.08	8.32	12.16	15.35	9.64
Total Revenue					
(NZ$fob)	181840	436575	413926	48583	1080924
Difference					
(NZ$fob)	-10706	-13169	+19213	+48583	43921

a assume prices in April 20 per cent higher than March. Only require prices in April to be higher than March for analysis to hold.

If it is assumed that 10 per cent of current exports to Australia in each month are transferred to the month following, then the total revenue effects can be assessed. Table 25 shows that for the 1983 season total revenue would have increased by about NZ$44,000 f.o.b. over the whole season, equivalent to $3.92

per tray stored, if this strategy had been followed. Thus, for this 10 per cent intra-season storage strategy, a 4.2 per cent increase in total returns from the Australian market was gained. As a final comment, the $3.92 per tray may be interpreted as the upper limit to the storage costs exporters would be willing to incur to proceed with the storage strategy.

2. Other Markets

Obviously, the importance of the Australian market for nectarine exports ensures that most of the benefits of extended storage used to influence intra-seasonal price trends will accrue in this market. All other markets took less than 10 per cent of total nectarine exports from New Zealand in 1983. Of these markets, the United States was the most important and so will serve as an example of the magnitude of returns available from the smaller markets.

Table 26 summarises the necessary asumptions required for an analysis of the United States market in 1983. The price flexibilities are based on Mckusick's (1978) research into the Californian nectarine industry. The price flexibility increases between December and January, the month of greatest supply, but then declines. The market share assumptions reflect the role of Chilean fruit in setting the market price over the season. The most significant result from Table 26 is that January and February are the only pair of months that will enable the intra-season storage policy to generate an increase in total revenue. Only January and February fulfill the two conditions of declining price flexibility and increasing price. This does not imply that it is not profitable to increase exports to the United States during March, when premium prices are obtained. Rather, the Table implies that for the given volume of exports in 1983, it does not pay to alter the distribution of that volume towards March.

TABLE 26

Price Flexibility Facing New Zealand Nectarine Exports in United States Market - 1983

	Month				
	December	January	February	March	April
Price flexibility (%)	0.25	0.60	0.40	0.20	0.20
Market share (%)	10.00	5.00	5.00	30.00	50.00
Price flexibility facing New Zealand (%)	0.025	0.03	0.02	0.06	0.10
Return per tray					
(NZ$fob)	6.72	4.78	5.10	9.10	n.a.
(NZ$cif)	13.72	11.42	11.75	15.77	n.a.

See Table 24 for definitions of terms.

After repeating the type of analysis presented in Table 25 transferring 10 per cent of nectarine exports sent to the United States in January to February, total f.o.b. receipts over the season increased by less than one per cent, equivalent to 54 cents per tray stored.

(c) Inter-Market Price Averaging (Revenue Maximising) Effect

Extending the storage life of nectarines not only means that supply distribution to a particular market can be altered over the season, but also allows supplies to be diverted between markets. Since the short storage time of nectarines requires exports to be airfreighted, extending storage life allows (usually) lower cost seafreight to be utilised. If a sea based storage technology that allows intermittent warming of stonefruit (or does away with the need for intermittent warming) can be developed, European, Middle-Eastern and Asian markets can be more fully developed. In the absence of a sea based technology, only the United States and the South Pacific offer potential for seafreight because of their comparatively short transit times.

Using Australia and the United States as an example, Table 27 shows that the combined total revenue earned on these two markets during January and February could have been increased by altering the distribution of exports supplied to the two markets. Total revenue increased because of a number of factors including:

(1) the lower price flexibility in the United States, encouraging supplies to be shifted from Australia to the United States. Because of the differences in price flexibilities, prices would increase in Australia faster than they would decrease in the United States,

(2) the increased f.o.b. returns from the United States market due to the difference between sea and airfreight rates (NZ$1.84 per tray).

Offsetting the forces increasing total revenue, the fact that Australia was

TABLE 27

Inter-Market Revenue Maximising - Australia and United States - 1983

	January			February		
	Australia	USA	Total	Australia	USA	Total
Actual 1983 Season's Prices and Volumes						
Volume (trays)	25006	1818		55524	543	
Price per tray						
Actual (NZ$cif)	11.44	11.42		11.84	11.75	
Actual (NZ$fob)	7.70	4.78		8.10	5.10	
(Including transport savings) (NZ$fob)	(7.70)	(6.62)		(8.10)	(6.94)	
Total Revenue						
Actual (NZ$fob)	192546	8690	201236	449744	2769	452513
(Including potential transport savings) (NZ$fob)	(192546)	(12035)	(204581)	(449744)	(3768)	(453512)
Estimated 1983 Season (Australia destined exports sent to USA by seafreight)						
Volume (trays)	25006	1818		55524	543	
	-3251	+3251		-3331	+3331	
	21755	5069		52193	3874	
Volume (% change)	-13	+79		-6	+513	
Price Flexibility Facing New Zealand	0.33	0.03		0.33	0.02	
Price (% change)	+4.29	-2.36		+1.98	-10.27	
Price (NZ$cif/tray)	11.93	11.15		12.07	10.54	
(NZ$fob/tray)	8.19	6.34		8.33	5.73	
Total Revenue (NZ$fob)	178173	32137	210310	434768	22198	456966
Net Change NZ$fob	-14373	+23447	+9074	-14976	+19429	+4453
NZ$fob/tray transferred			2.79			1.34

a higher priced market meant that for each tray diverted from Australia to the United States, a loss of at least NZ$1.08 f.o.b. per tray in January ($7.70-$6.62) and NZ$1.16 f.o.b. per tray in February ($8.10-$6.94) would be made, even after the transport saving was added to the United States returns. As the degree of diversion increases, this gap increases, setting a limit on the volumes able to be diverted. After experimentation, it was found that if 13 per cent of exports to Australia in January were seafreighted to the United States, and six per cent in February, total revenue from the two markets was maximised. On a per tray basis, supply diversion to the United States equalled NZ$2.79 f.o.b. per tray diverted in January, and NZ$1.34 f.o.b. per tray diverted in February. These amounts represent the upper limits to the additional seafreight charges exporters could have paid for a storage and transport technology allowing nectarines to be seafreighted to the United States.

The analysis presented in Table 27 for exports destined for Australia being diverted to the United States show that even though the United States market returned lower f.o.b. prices than Australia, revenue could be increased given sufficient transport savings to the lower priced market, and a lower price flexibility in the lower priced market. If instead of being diverted to the United States market, the Australian exports were diverted to higher priced markets, such as French Polynesia, New Caledonia and the Middle-East, even greater returns could have been achieved. Of course, the greatest returns would be achieved if supply diversion could be avoided, and the volume of exports available increased to meet additional export opportunities.

(d) Transport Costs

Table 21 in Section 3.4.5 reported representative airfreight charges for exports to individual markets in 1983. Storage technologies that extend available transport time sufficiently to allow seafreight of nectarine exports, will probably allow economies to be made in total transport costs. In the absence of any information as to the precise costs of the new storage and transport technology, current seafreight rates for integral containers are used to identify the likely magnitude of cost saving through the use of seafreight. The gap between air and integral sea container charges at least indicates the range within which any new sea transport technology must be priced if it is to be attractive compared to airfreight.

Table 28 reports the difference between air and sea freight rates for the 1983 export season, and generates a total cost difference by multiplying the gap between rates by total exports from January onwards. Nectarine exports in December are likely to continue to travel by air so that early season premiums are gained.

In total, it is calculated that over NZ$73,000 in freight costs could have been saved through utilising sea rather than air transport after January. Excluding shipments to the Middle-East for which shipping rates were unavailable, the savings are equivalent to NZ$0.61 per tray exported. Excluding exports to Australia which only save NZ$0.50 per tray if shipped, the average transport saving is NZ$2.22 per tray.

TABLE 28

Difference Between Sea and Air Freight Rates for Nectarines - 1983

Country	Freight Rates Air[a]	Freight Rates Sea[b]	Difference	Total Exports January to March[c]	Value of Freight Rate Difference
	(NZ$ per tray)			(trays)	(NZ$)
American Samoa	9.93	3.99	5.94	59	350.46
Cook Islands	3.78	3.49	0.29	35	10.15
Fiji	3.61	3.49	0.12	86	10.32
French Polynesia	5.03	3.97	1.06	2671	2831.26
Nauru	13.46	3.99	9.47	24	227.28
New Caledonia	4.17	3.49	0.68	1255	853.40
Niue	9.93	3.99	5.94	6	35.64
Vanuatu	6.24	3.49	2.75	74	203.50
Wallis and Futuna	8.04	3.99	4.05	18	72.90
Western Samoa	4.56	3.99	0.57	63	35.91
Australia	3.70	3.20	0.50	112184	56092.00
Brunei	8.30	3.30	5.00	4	20.00
Hong Kong	6.67	3.30	3.47	498	1728.06
Malaysia	4.99	3.30	1.69	10	16.90
Singapore	6.88	3.30	3.58	296	1059.68
United States (West Coast)	6.62	3.64	2.98	2387	7113.26
Belgium	15.05	3.17			
Germany	14.32	3.17	11.15	232	2586.80
United Kingdom	15.48	3.17			
Bahrain	13.98	n.a.		894	
Kuwait	14.23	n.a.		2005	
Saudi Arabia	13.98	n.a.		429	
United Arab Emirates	13.80	n.a.		248	
TOTAL					73247.52

[a] from Table 21

[b] Based on FCL rates supplied by NZ Shipping Corporation.

[c] NZDS, pers. comm.

It is significant that the data presented in Table 28 show that the maximum freight saving (NZ$11.15/tray) would be earned on exports seafreighted to Europe.

(e) Additional Exports

Given the development of a technology that will extend nectarine storage and its availability during the 1983 season, it is likely that a higher volume of exports from 1983 production would have eventuated. This would arise because of two factors. Firstly, since the supply of export quality nectarines limits export volume in March (rather than inadequate prices), extended storage would allow nectarines harvested in February to be marketed during March. Secondly, the ability to seafreight nectarines would encourage additional export volume since f.o.b. returns would increase due to lower freight charges. Exports would increase to at least the point where the additional exports had driven the f.o.b. price down to the level returned using airfreight. A greater volume of exports would be sold at the same f.o.b. price.

1. Higher Late-Season Export Packout

In nearly every market prices peak during March as available supplies diminish. If the export packout in February was increased from around eight per cent to 8.5 per cent, and the additional fruit stored for export in March, export supplies available in March would increase by 10 per cent. Assuming that this additional supply was distributed according to the actual market distribution in March, each market would have an additional 10 per cent of export volume sold on it. Given the strong demand for fruit during March, prices received are unlikely to be significantly affected, so that the additional volume can be valued at the actual f.o.b. prices received during the 1983 season. Table 29 shows that the additional 3,547 trays sold would earn NZ$43,664 f.o.b. giving a per tray value of NZ$12.31 f.o.b. Taking this return back to a net grower return shows that growers would receive NZ$9.43 per tray. To obtain a similar return on the domestic market in February, an auction floor return of NZ$12.98 would have been necessary. In 1983 this would probably have been achieved due to abnormally high prices paid (hail damage affected supplies of summer fruit), but if 1983 had followed the price pattern of previous years a return of around NZ$7.00 on the auction floor would have been received, giving growers a net return of NZ$4.05. The difference between grower returns for export and domestic selling would therefore be NZ$5.38 per tray ($9.43-$4.05), giving over 3,547 trays, an increase in revenue of NZ$19,083 from export. At the f.o.b. level, the NZ$12.31 f.o.b. per tray exceeds the assumed auction floor price of NZ$7.00 per tray by $5.31, a revenue gain of NZ$18,835 f.o.b.

TABLE 29

Value of Additional Late Season Nectarines - 1983

Country	Additional Volume	Unit Value	Total Value
	(trays)	(NZ$fob per tray)	(NZ$fob)
American Samoa	2	9.95	19.90
Cook Islands	2	17.39	34.78
Fiji	2	9.62	19.24
French Polynesia	69	9.73	671.37
Nauru	2	10.66	21.32
New Caledonia	43	10.18	437.74
Niue	1	8.07	8.07
Vanuatu	1	11.21	11.21
Wallis and Futuna	1	8.88	8.88
Western Samoa	5	7.18	35.90
Australia	3165	12.47	39467.55
Brunei	1	12.73	12.73
Hong Kong	27	12.36	333.72
Malaysia	1	9.14	9.14
Singapore	4	11.91	47.64
United States	3	12.47	37.41
Belgium	1	8.51	8.51
Germany	23	10.36	238.28
United Kingdom	1	8.33	8.33
Bahrain	65	4.59	298.35
Kuwait	96	17.35	
Saudi Arabia	7	16.69	1665.60
United Arab Emirates	25	10.73	268.25
Total	3547	12.31	43663.92

Source: Based on data supplied by NZDS, pers. comm.

2. Higher F.O.B. Returns

Lower freight rates paid for seafreight would also encourage additional exports. Given the difference between air and sea freight charges, and assumptions regarding the sensitivity of particular markets to higher volumes of exports, the level of additional exports that drives the seafreight f.o.b. price down to the level returned using airfreight can be calculated. These conditions are reported in Table 30, which show a projected additional export volume of 106,352 trays, valued at NZ$950,513 f.o.b. This additional export revenue must be offset with the decline in revenue earned on the domestic market. The additional 106,352 trays exported represents a 7.1 per cent decline in domestic sales volume during 1983. Assuming a domestic market price flexibility of 0.3 and a $9 per tray domestic price, the domestic price would increase by 2.1 per cent to $9.19. Taken together, the volume decline and price increase on the

TABLE 30

Increased Exports from January to March
Due to Lower Freight Charges - 1983

	(1) Actual 1983 Unit Value[a]	(2) Actual 1983 Volume[b]	(3) Freight Rate Differential[c]	(4) Price Flexibility[d] (for 1% change in supply)	(5) Percentage Volume Increase[e]	(6) Additional Exports Volume[f]	(7) Additional Exports Value[g]
	(NZ$fob/tray)	(trays)	(NZ$fob/tray)	(%)	(%)	(trays)	(NZ$fob)
Pacific Islands	9.07	4291	3.75	0.70	59	2534	22983.28
Australia	9.25	112184	0.50	0.90	6	6738	62326.50
Asia	10.18	808	3.55	0.10	349	2818	28687.24
USA	7.18	2387	2.98	0.02	2075	49535	355661.30
Europe	10.36	232	11.15	0.05	2153	4994	51737.84
Middle-East	10.80	3576	6.00[h]	0.05	1111	39733	429116.40
Total						106352	950512.66

[a] based on data supplied by NZDS, pers. comm.

[b] from Table 28.

[c] from Table 28.

[d] for Australia and USA based on data in Tables 24 and 26 respectively. Values for Asia, Europe and Middle-East assume New Zealand has a small market share.

[e] (5) = (3)/(1)/(4).

[f] (6) = (5) * (2).

[g] (7) = (6) * (1).

[h] estimate.

domestic market is calculated to produce a NZ$692,735 decline in revenue earned. Thus, the net gain from the additional 106,352 trays exported is NZ$257,778 or $2.42 per additional tray exported. This can be regarded as the maximum premium exporters could have paid as either higher transport costs associated with CA sea transport, or in order to attract export fruit from domestic growers.

3.5.3 Analysis Based on Forecasted Export Volume for 1990

(a) Introduction

In Section 3.2.3, it was estimated that nectarine production in 1990 would be 12,810 tonnes, a 112 per cent rise on the 1983 level. It is likely that seasonal spread of the nectarine harvest in 1990 will follow a similar pattern to that in 1983, given expected trends in tree plantings of early, mid and late season varieties. It is also likely that of the additional production forecasted for 1990, a much higher proportion of it is destined for export than of the 1983 production. Table 31 summarises a number of important assumptions made regarding harvest spread and export packout in 1990. On average the export packout of production additional to the 1983 level is assumed to be 20 percentage points higher than the average export packout for the 1983 production level. This gives a seasonal export packout of 18.2 per cent of total production in 1990. The Table shows that for a 112 per cent increase in total production between 1983 and 1990, available export volumes increase by 409 per cent to 2,331 tonnes (from 458 tonnes).

In order to analyse the effect of these higher volumes on export markets, and the role of storage in the marketing of nectarines, additional assumptions must be made. Firstly, it is assumed that population and income growth in all export markets results in a 15 per cent rise in real 1983 market prices for New Zealand nectarines sold in 1990, for export volumes up to the 1983 export level. Volumes sold above the 1983 level will cause price declines to the extent indicated by price flexibilities. Secondly, it is asumed that transport costs remain fixed in real terms at their 1983 level. A case may be made for increasing real freight-rates, especially in the light of growing competition for airfreight space. However, it is the difference between sea and airfreight rates that is most important for the following analysis. A small increase in both sea and airfreight rates would not alter this difference greatly. Also, since airfreight space is likely to be more limiting than seafreight, the no-change assumption will not penalise airfreight excessively in the analysis. The final assumption relates to airfreight space. It is assumed that a further 40 per cent airfreight space for nectarines will be available in 1990 on scheduled passenger services. Although in Section 3.4.5 it was considered that freight load factors were currently at least 80 per cent, the assumption of an additional 40 per cent space allows for growth in scheduled airline services by 1990.

TABLE 31

Seasonal Distribution and Export Packout of 1990
Nectarine Production

Month	Local Market	Export Market	Total Production	Export Packout
		(tonnes)		(%)
1983 Season				
December	470	3	473	0.6
January	2227	105	2332	4.5
February	2580	220	2800	7.9
March	296	130	426	30.5
Season	5573	458	6031	7.6
Additional Production to 1990				
December	420	109	529	20.6
January	1976	641	2617	24.5
February	2273	881	3154	27.9
March	237	242	479	50.5
Season	4906	1873	6779	27.6
1990 Season - Total Production				
December	890	112	1002	11.2
January	4203	746	4949	15.1
February	4853	1101	5954	18.5
March	533	372	905	41.1
Season	10479	2331	12810	18.2

Utilising the assumptions made above, Table 32 summarises the potential marketing environments existing in 1990. The table shows that three major possibilities are recognised:

1. Nectarines sold according to market distribution and transport systems utilised in 1983. Because of the upper limit to airfreight space assumed, the domestic market must absorb much greater quantities.

2. Development of land based storage technology. Allows price averaging within and between markets for exports airfreighted, but the technology's main impact is in allowing seafreight to United States and Pacific Islands. The export surplus required to be sold on the domestic market is reduced, strengthening prices.

3. Development of land and sea based storage and transport technology. The barrier to large scale sales of nectarines to Europe, the Middle-East and Asia (including Japan assuming fumigation development is successful) is removed when successful long-term sea storage/transport technology is developed. All available exports are able to be sold on a broader base of export markets.

TABLE 32

Marketing Nectarine Production in 1990

Market	Marketing Environment		
	1983 Markets and Marketing System	Extended Storage Technology	
		Land Based	Land and Sea Based
Domestic	Due to lack of airfreight space, over 70% nectarines destined for export marketed domestically. Dometic supplies over season increase 120% rather than 90% from 1983 level.	Export volume surplus sold on domestic market reduced degree of price strengthening. Possibility of intra-seasonal price averaging also.	Reduced export volume surplus required to be sold on domestic market.
Export	Only 641 tonnes able to be exported. Prices received very high. Low prices received domestically may encourage use of airfreighters in spite of cost.	Volumes sent to USA increased due to ability to seafreight. Pacific Islands also take some additional supplies. Some seafreight to Australia also in spite of being no cheaper than airfreight.	Large scale development of European, Asian (Including Japan) and Middle-Eastern market.

These possible marketing environments in 1990 are evaluated in greater detail in the following sections.

(b) Marketing of 1990 Season's Production Under Present Marketing System

Given the assumption that an additional 40 per cent of nectarine exports (over 1983) can be airfreighted to each export market, and the assumption of a 15 per cent increase in real c.i.f. prices for a level of nectarine exports equivalent to the 1983 level, then after further assumptions are made regarding price flexibilities in each market, c.i.f. prices paid for the 1990 level of nectarine exports can be calculated. Price flexibilities in the Australian and United States markets were reported in Tables 24 and 26 respectively. For all other export markets, a price flexibility of 0.05 is assumed. On the domestic market a price flexibility of 0.20 was assumed in December and March, and 0.30 in January and February. Table 33 summarises the volume and value of nectarines sold on the domestic and export market. Less than 30 per cent of available exports can actually be airfreighted and so must be sold on the domestic market. Exports that are sold on export markets receive higher prices than those obtained in 1983, due to the fact that the depressing effects of higher volumes were more than offset by increases in real prices. Table 33 clearly shows that the export volume available but not exported because of the airfreight limit, accentuates the downward pressure on prices in the domestic market caused by higher production. Over the entire season, the tray value for export fruit is nearly 100 per cent higher than the value of domestically sold fruit, creating a large incentive to break the freight space constraint. In the absence of seafreight this can only be done through the use of specialised airfreighters. Assuming freight costs were at least doubled for extra airfreight space, as they would be under this option given an absence of backloading, reduces f.o.b. returns to well below domestic market levels. In some cases f.o.b. returns become negative. Thus, the economic viability of specialised airfreighting operations is doubtful.

TABLE 33

Domestic and Export Sales of Nectarines in 1990

Market	Month				Season
	December	January	February	March	
Export Market (All Markets)					
Availability (trays)	30270	201622	297568	100541	630001
Export Surplus (trays)	29135	161892	214325	51352	456704
Actual Exports (trays)	1135	39730	83243	49189	173297
Unit Value (NZ$fob/tray)	12.46	7.90	8.90	14.31	10.27
Total Value (NZ$fob)	14140	313792	748252	703985	1780169
Domestic Market					
Availability (trays)	240541	1135946	1311622	144054	2832163
Export Surplus (trays)	29135	161892	214325	51352	456704
Actual (trays)	269676	1297838	1525947	195406	3288867
Unit Value (NZ$/tray)	10.71	4.50	4.44	9.83	5.30
Total Value (NZ$)	2888230	5840271	6775205	1920841	17424547

TABLE 34

Nectarine Marketing 1990: December

	Market			
	Domestic	Australia	United States	Pacific Islands
Estimated 1990 Marketings				
Volume (trays)	269676	nil	970	141
Price (NZ$cif/tray)			18.06	24.59
(NZ$fob/tray)	10.71		11.41	19.54
Revenue (NZ$fob)	2888230	nil	11068	2755
Estimated Sales Changes Due to Use of Seafreight				
Volume (trays)	-10500	nil	+10000	+500
(% change)	-4		+931	+255
Estimated Price Changes Due to Changes in Sales Volume				
Price Flexibility	0.30		0.025	0.05
Cif Price (% change)		nil	-23.3	-12.7
(NZ$cif/tray)			13.86	21.46
Fob Price - Air (NZ$fob/tray)			7.21	16.41
- Sea (NZ$fob/tray)			9.05	17.67
Domestic Price (% change)	+1.2			
(NZ$/tray)	10.84			
Revenue Earned (NZ$fob)				
- Air			6994	2314
- Sea			90500	8835
- Domestic	2814888			
- Total	2814888	nil	97494	11149
Change in Revenue Earned (NZ$fob)	-73342	nil	+86426	+8394
Net Change Over All Markets	NZ$21478 fob			

TABLE 35

Nectarine Marketing 1990: January

	Market			
	Domestic	Australia	United States	Pacific Islands
Estimated 1990 Marketings				
Volume (trays)	1297838	34998	2543	1490
Price (NZ$cif/tray)		11.42	15.00	15.62
(NZ$fob/tray)	4.50	7.68	8.35	10.57
Revenue (NZ$fob)	5840271	268785	38145	15749
Estimated Sales Changes Due to Use of Seafreight				
Volume (trays)	-30000	nil	+20000	+10000
(% change)	-2.3	nil	+686	+571
Estimated Price Changes Due to Change in Sales Volume				
Price flexibility	0.2	0.33	0.03	0.05
Cif Price (% change)		nil	-20.6	-28.6
(NZ$cif/tray)		11.42	11.91	11.15
Fob Price - Air (NZ$fob/tray)		7.68	5.26	6.10
- Sea (NZ$fob/tray)		n.a.	7.10	7.36
Domestic Price (% change)	+0.5			
(NZ$/tray)	4.52			
Revenue Earned (NZ$fob)				
- Air		268785	13376	9089
- Sea			142000	73600
- Domestic	5730628			
- Total	5730628	268785	155376	82689
Change in Total Revenue (NZ$fob)	-109643	nil	+117231	+66940
Net Change Over All Markets NZ$74528 fob				

TABLE 36

Nectarine Marketing 1990: February

	Market			
	Domestic	Australia	United States	Pacific Islands
Estimated 1990 Marketings				
Volume (trays)	1525947	77416	7575	2839
Price (NZ$cif/tray)		11.82	15.56	14.75
(NZ$fob/tray)	4.44	8.08	8.91	9.70
Revenue (NZ$fob)	6775205	625521	67493	27538
Estimated Sales Changes Due to Use of Seafreight				
Volume (trays)	-95000	nil	+80000	+15000
(% change)	-6	nil	+956	+428
Estimated Price Changes Due to Changes in Sales Volume				
Price flexibility	0.2	0.33	0.02	0.05
Cif Price (% change)		nil	-19.1	-21.4
(NZ$cif/tray)		11.82	12.58	11.59
Fob Price - Air (NZ$fob/tray)		8.08	5.93	6.54
- Sea (NZ$fob/tray)		n.a.	7.77	7.80
Domestic Price (% change)	1.2			
(NZ$/tray)	4.50			
Revenue Earned (NZ$fob)				
- Air		625521	44920	18567
- Sea			621600	117000
- Domestic	6439262			
- Total	6439262	625521	666520	135567
Change in Total Revenue (NZ$fob)	-335943	nil	+599027	+108029

Net Change Over All Markets NZ$371113 fob

TABLE 37

Nectarine Marketing 1990: March

	Market			
	Domestic	Australia	United States	Pacific Islands
Estimated 1990 Marketings				
Volume (trays)	195406	44432	3443	1662
Price (NZ$cif/tray)		16.80	21.46	16.98
(NZ$fob/tray)	9.83	13.06	14.81	11.93
Revenue (NZ$fob)	1920841	580282	50991	19828
Estimated Sales Changes Due to Use of Seafreight				
Volume (trays)	-20000	+5000	+10000	+5000
(% change)	-10	+11	+190	+201
Estimated Price Changes Due to Change in Sales Volume				
Price Flexibility	0.3	0.25	0.06	0.05
Cif Price (% change)		-2.8	-11.4	-10.0
(NZ$cif/tray)		16.33	19.01	15.27
Fob Price - Air (NZ$fob/tray)		12.59	12.36	10.22
- Sea (NZ$fob/tray)		12.59	14.20	11.48
Domestic Price (% change)	+3.1			
(NZ$/tray)	10.13			
Revenue Earned (NZ$fob)				
- Air		559399	42555	16986
- Sea		62950	142000	57400
- Domestic	1776863			
- Total	1776863	622349	184555	74386
Change in Total Revenue (NZ$fob)	-143978	+42067	+133564	+54558
Net Change Over all Markets	NZ$86211 fob			

(c) Economic Benefits from Storage Technology Allowing Seafreight to Markets with Transit Time up to Twelve Days

The ability to transport fruit to markets with a transit time of up to twelve days restricts the potential markets accessed by seafreight to Australia, the United States, and the Pacific Islands. The amount of fruit able to be shipped to these markets in order to generate the greatest gain in overall revenue earned from nectarines, depends on the interaction of a number of factors. These factors include the percentage by which the seafreighted nectarines increase New Zealand's exports to a market, the price flexibility facing New Zealand exports, the level of prices in each market, and the degree to which seafreight changes transport costs. Since most of these factors vary over the season, the optimum level of seafreight to particular markets will change in each month.

A monthly analysis of the potential use of seafreight to the Australian, United States and Pacific Island markets is reported in Tables 34 to 37. The analysis assumed that the level of airfreighted sales to each market would be maintained, so that only additional supplies would be sent by sea. An attempt was made during the analysis to maximise the gain in total revenue earned during each month by experimenting with alternative levels of seafreight to each market. Thus, the quantities derived in Tables 34 to 37 are approximately the levels of seafreight use which maximise total revenue.

TABLE 38

Net Revenue Changes in Each Market Due to Sea Transport[a]

Market	Month				Season
	December	January	February	March	
			(NZ$fob)		
Domestic	-73342	-109643	-335943	-143978	-662906
Australia	nil	nil	nil	+42067	+42067
United States	+86426	+117231	+599027	+133564	+936248
Pacific Islands	+8394	+66940	+108029	+54558	+237921
All Markets	+21478	+74528	+371113	+86211	+553330
Total Volume Seafreighted (trays)	10500	30000	95000	20000	155500
Net Revenue Gain Per Tray Seafreighted (NZ$fob)	2.05	2.48	3.91	4.31	3.56

[a] See Tables 34-37

Table 38 summarises the monthly net changes in net revenue calculated in Tables 34 to 37. Over the entire season, the net change in total revenue earned is NZ$553,330 f.o.b., about a three per cent rise in total domestic and export income earned from nectarines as reported in Table 33. In terms of the nectarines seafreighted, the increased revenue is equivalent to NZ$3.56 over the entire season, an indication of the ability to pay for any additional seafreight charges arising out of the introduction and use of the new technology.

Table 33 also reported the surplus in export volumes that had to be sold on the domestic market because of a lack of airfreight space. The analysis undertaken in Tables 34 to 37 reveals that the ability to seafreight nectarines to Australia, the Pacific Islands and the United States reduces but by no means eliminates these monthly surpluses.

Table 38 reports the volume of nectarines seafreighted in each month. In December, 36 per cent of the export surplus reported in Table 33 is seafreighted, while in January, February and March 19, 44 and 39 per cent respectively of the surplus is now exported by sea. Therefore, in the absence of a storage and transport technology that opens the European, Asian and Middle-Eastern markets for high volume sales, it will not be profitable to export the remaining export surplus (in terms of maximising revenue earned by the nectarine industry).

On the domestic market, the seasonal price and volume data presented in Table 33 suggest that land based storage offers potential for increasing the average revenue per tray sold domestically. Specifically, the difference in the estimated market prices for February and March is large enough to allow a proportion of available supply in February to be stored and sold in March. Table 39 shows that if five per cent of nectarines marketed in February were stored and marketed in March, an increase of NZ$156,768 in revenue earned during February and March would result: a two per cent increase. In terms of the 76,297 trays that would be stored, the revenue gain is equivalent to NZ$2.05 per tray.

(d) Economic Benefits From Storage Technology Allowing Seafreight to All Markets

The analysis in the previous section indicated that a storage and transport technology that enabled nectarines to be seafreighted to Australia, the United States and the Pacific Islands reduced the available export volume sold domestically by 155,500 trays over the whole season. By enabling these nectarines to be exported, the technology allowed combined market returns to be increased by NZ$553,330 f.o.b. While the additional 155,500 trays represented a large reduction in available exports sold domestically, 52 per cent of available exports were still not exported. These potential exports will only be exported if it is assumed that a storage technology is developed that allows seafreighted exports to Europe, Asia and the Middle-East.

TABLE 39

Revenue Gains Through Storage On Domestic Market

	Month February	March
Estimated 1990 Marketings		
Volume (trays)	1525947	195406
Price (NZ$/tray)	4.44	9.83
Revenue (NZ$)	6775205	1920841
Effect of Storing 5% February's Availability for Sale in March		
Volume (trays)	1525947	195406
	-76297	+76297
	1449650	271703
(% change)	-5.0	+39.0
Price Flexibility	0.2	0.3
Price (% change)	+1.0	-11.7
(NZ$/tray)	4.48	8.68
Revenue (NZ$)	6494432	2358382
Net Revenue Change (NZ$)	-280773	+437541
Net Gain NZ$156768		

Table 40 summarises the volume of nectarines available for export in each month after the air and seafreighted nectarines allocated in Section 3.5.3 (c) are accounted for. A total of 301,204 trays are available over the season for export by seafreight to Europe, Asia and the Middle-East. The estimated 1990 airfreighted quantities to these three regions were 336, 1,137 and 6,496 trays respectively, so the available exports require large increases in exports to the countries making up these regions. However, since the estimated distribution of exports in 1990 was based on the markets exported to in 1983, many countries within each region were not represented.

TABLE 40

Available Nectarine Exports During Season

	Month				
	December	January	February	March	Season
			(trays)		
Total Availability	30270	201622	297568	100541	630001
Airfreighted	1135	39730	83243	49189	173297
Seafreighted to Australia, United States and Pacific Islands	10500	30000	95000	20000	155500
Available Surplus	18635	131892	119325	31352	301294
(% of Total)	(62)	(65)	(40)	(31)	(48)

The volumes of nectarines available to be seafreighted to Europe, Asia and the Middle-East are far larger than any previous nectarine marketing experience.[3] Given this fact, instead of beginning with a c.i.f. price and estimating the volumes exported and f.o.b. prices, the analysis below first estimates the f.o.b. price required for the available exports to be exported. Assumptions are then made regarding the likely c.i.f. price in each region. From this, an estimate of the additional revenue gained through selling the available exports on the export market rather than the domestic market can be made.

Table 41 calculates the minimum f.o.b. return per tray that the export surplus in each month must generate for the income lost on the domestic market to be recovered. The analysis begins from the domestic market conditions resulting after accounting for seafreighting operations to Australia, the United States and the Pacific Islands.

From Table 41, it can be seen that seafreighted exports to Europe, the Middle-East and Asia must return at least NZ$4.38 f.o.b. per tray to offset the reduction in revenue on the domestic market. From estimates of f.o.b. returns for these regions in 1990 (see Table 42) it is apparent that returns would have to drop considerably before the minimum required return was reached. This conclusion is accentuated by adding transport cost discounts, arising from using seafreight, to f.o.b. returns (see Table 42).

3 The volumes are still very small in comparison to other New Zealand fruit exports (e.g. apples, kiwifruit), and especially small in relation to total fruit imports by countries making up the European, Asian and Middle-Eastern regions.

TABLE 41

Effect of Removing Export Surplus From Domestic Market

	Month				Season
	December	January	February	March	
Estimated 1990 Marketings (From Tables 3.34-3.37)					
Volume (trays)	259176	1267838	1430947	175406	3133367
Price (NZ$/tray)	10.84	4.52	4.50	10.13	5.35
Revenue (NZ$)	2809468	5730628	6439262	1776863	16756221
Available Export Surplus Removed					
Volume (trays)	18635	131892	119325	31352	301204
(% change)	-7.2	-10.4	-8.3	-17.9	-9.6
Estimated Price Changes Due to Change in Sales Volume					
Price Flexibility (%)	0.3	0.2	0.2	0.3	0.2
Domestic Price (% change)	+2.2	+2.1	+1.7	+5.4	+1.9
(NZ$/tray)	11.07	4.61	4.58	10.67	5.45
Domestic Market Volume and Revenue					
Volume (trays)	240541	1135946	1311622	144054	2832163
Revenue (NZ$)	2662789	5236711	6007229	1537056	15443785
Change in Revenue (NZ$)	-146679	-493917	-432033	-239807	-1312436
Revenue Change per Tray Removed (NZ$/tray)	8.16	3.74	3.62	7.65	4.36

TABLE 42

Estimated FOB Returns in European, Asian and Middle-Eastern Markets - 1990

Market	Month			
	December	January	February	March
	(NZ$fob/tray)			
Airfreight				
Europe	11.40			13.50
Asia	10.60	11.10	10.80	14.70
Middle-East	16.60	12.90	12.00	15.50
Seafreight [a]				
Europe	22.55			24.65
Asia	14.10	14.60	14.30	18.20
Middle-East	22.60	18.90	18.00	21.50
Minimum Fob Return Required [b]	8.16	3.74	3.62	7.65

a Difference between air and sea freight rates added to airfreight data.

b From Table 41.

Tables 43 to 45 report an analysis of returns from the European, Asian and Middle-Eastern markets, given a set of assumptions regarding the level of c.i.f. prices in each market. In general, the c.i.f. prices are around 30 per cent lower than those assumed for 1990 in the absence of seafreight. Of the monthly export surplus removed from the domestic market (reported in Table 41), 40 per cent was allocated to Europe, and 30 per cent each to Asia and the Middle-East. Given the transit times to each market (three weeks to Asia, three to four weeks to the Middle East, and four to five weeks to Europe), it was assumed that the seafreighted nectarines were sold in the month following their export. Based on these assumptions, Tables 43 to 45 show that the combined revenue gain on the three markets was NZ$3,564,857 f.o.b. (NZ$11.84 per tray). When combined with the revenue loss on the domestic market of NZ$1,312,436 (NZ$4.36 per tray), the net gain to being able to seafreight nectarines to Europe, Asia and the Middle-East is NZ$2,252,421 f.o.b. (NZ$7.48 per tray). Of course, the net gain calculated depends largely on the c.i.f. price assumptions made for each market. Sensitivity analysis undertaken using different price assumptions reveals that c.i.f. prices in each month on all markets would have to be reduced by over $9 per tray before the net gain from the seafreight operations was eliminated.

TABLE 43

Economic Benefits of Utilising Seafreight to European Markets

	Month					Season
	December	January	February	March	April	
Estimated 1990 Marketings[a]						
Volume (trays)	11	nil	nil	325	nil	336
Price (NZ$cif/tray)	26.40			28.50		28.43
(NZ$fob/tray)	11.40			13.50		13.43
Revenue (NZ$fob)	125.40	nil	nil	4387.50	nil	4512.90
Additional Volume Seafreighted						
(Shipped previous month)						
Volume (trays)		7454	52758	47730	12541	120483
Prices Received						
Cif (NZ$cif/tray)	26.40	16.00	16.00	19.00	20.00	
Fob - Air (NZ$fob/tray)	11.40	1.00	1.00	4.00	5.00	
- Sea (NZ$fob/tray)	22.55	12.15	12.15	15.15	16.15	
Revenue - Air (NZ$fob)	125.40	nil	nil	1300.00	nil	
- Sea (NZ$fob)	nil	90566.10	641009.70	723109.50	202537.15	
- Total	125.40	90566.10	641009.70	724409.50	202537.15	1658647.80
Change in Revenue						
(NZ$fob)	nil	90566.10	641009.70	720022.00	202537.15	1654134.90

[a] Distributing 1990 marketings according to 1983 market and seasonal distribution.

TABLE 44

Economic Benefits of Utilising Seafreight to Asian Markets

	Month					Season
	December	January	February	March	April	
Estimated 1990 Marketings[a]						
Volume (trays)	4	159	541	433	nil	1137
Price (NZ$cif/tray)	17.60	18.10	17.80	21.70		19.33
(NZ$fob/tray)	10.60	11.10	10.80	14.70		12.33
Revenue (NZ$fob)	42.40	1764.90	5842.80	6365.10	nil	14015.20
Additional Volume Seafreighted (Shipped previous month)						
Volume (trays)		5591	39567	35798	9406	90362
Prices Received						
Cif (NZ$cif/tray)	17.60	13.00	13.00	15.00	16.00	
Fob - Air (NZ$fob/tray)	10.60	6.00	6.00	8.00	9.00	
- Sea (NZ$fob/tray)	14.10	9.50	9.50	11.50	12.50	
Revenue - Air (NZ$fob)	42.40	954.00	3246.00	3464.00	nil	
- Sea (NZ$fob)	nil	53114.50	375886.50	411677.00	117575.00	
- Total	42.40	54068.50	379132.50	415141.00	117575.00	965959.40
Change in Revenue (NZ$fob)	nil	52303.60	373289.70	408775.90	117575.00	951944.20

[a] Distributing 1990 marketings according to 1983 market and seasonal distribution

TABLE 45

Economic Benefits of Utilising Seafreight to Middle-Eastern Markets

	Month					Season
	December	January	February	March	April	
Estimated 1990 Marketings[a]						
Volume (trays)	9	485	1814	2715	nil	5023
Price (NZ$cif/tray)	30.60	26.90	26.00	29.50		27.99
(NZ$fob/tray)	16.60	12.90	12.00	15.50		13.99
Revenue (NZ$fob)	149.40	6256.50	21768.00	42082.50	nil	70256.40
Additional Volume Seafreighted (Shipped previous month)						
Volume (trays)		5590	39567	35797	9405	90359
Prices Received						
Cif (NZ$cif/tray)	30.60	18.00	18.00	20.00	21.00	
Fob - Air (NZ$fob/tray)	16.60	4.00	4.00	6.00	7.00	
- Sea (NZ$fob/tray)	22.60	10.00	10.00	12.00	13.00	
Revenue - Air (NZ$fob)	149.40	1940.00	7256.00	16290.00	nil	
- Sea (NZ$fob)	nil	55900.00	395670.00	429564.00	122265.00	
- Total	149.40	57840.00	402926.00	445854.00	122265.00	1029034.40
Change in Revenue						
NZ$fob	nil	51583.50	381158.00	403771.50	122265.00	958778.00

[a] Distributing 1990 marketings according to 1983 market and seasonal distribution.

3.6 Summary and Conclusions

3.6.1 Introduction

The analysis presented in the preceding section is summarised in Tables 46 and 47. The results are indicative of the returns likely to be achieved from the application of CA technology in the storage and transport of nectarines, but are not necessarily the optimal returns possible. An optimal solution would require a simultaneous analysis of all individual analyses reported in Tables 46 and 47. In addition, the assumptions required to complete the individual analyses make any claim to optimality unwarranted.

It should also be recognised that the benefits calculated in the preceding sections refer specifically to the set of market conditions holding during the 1983 season, or assumed to hold during the 1990 season. A different combination of product prices across the various markets would have produced a different set of results. However, while the level of benefits is dependent on the level of market returns, the relative benefits contained in the individual analyses presented in Tables 46 and 47 would be less affected.

3.6.2 Summary of Analysis Based on 1983 Export Volume

Table 46 reports the analysis of a number of potential benefits arising out of the use of CA technology. The analysis was based upon the level of nectarine production in 1983, and the distribution of sales among individual markets in that season. Four major benefits arising from the application of CA technology in the storage and transport areas were recognised:

1. Intra-seasonal price averaging, i.e. using CA storage to alter the monthly distribution of exports within individual markets in order to capture premiums in months of high prices. End of season price premiums are especially significant in most markets. For example, in the Australian market if 10 per cent of exports in each month were stored and sold in the following month, total f.o.b. returns from the market were estimated to increase by almost NZ$44,000, equivalent to $3.92 per tray stored. The $3.92 per tray can be regarded as the upper limit exporters would have been prepared to pay for storage costs incurred on the stored fruit.

2. Inter-market price averaging, i.e. using CA transport to alter the distribution of exports among markets, either capturing premiums available in particular markets, or utilising differences across markets through the effect supply changes have on market prices. In the latter case, supplies are removed from more sensitive markets (exerting upward pressure on prices) to less sensitive markets (exerting a smaller downward pressure on prices). The analysis undertaken found that in January and February, it was possible to increase total revenue earned from the Australian and United States markets by altering the distribution of exports in favour of the United States, so long as the additional exports were seafreighted (increasing the f.o.b. return from the U.S.A.). After experimentation, it was found that if 13 per cent of exports to Australia in January and six per cent in February, were seafreighted to the United States, total revenue earned from the two markets was maximised. On a per tray basis, supply diversion to the United States resulted in increased returns of NZ$2.79 f.o.b. per tray diverted in January, and NZ$1.34 f.o.b. per tray diverted in February. These amounts represent the upper limits to the additional seafreight charges exporters would have paid for a storage and transport technology allowing nectarines to be seafreighted to the United States. It must be re-emphasised that these amounts are indicative only of the benefits obtainable using CA technology. They apply specifically to the set of

TABLE 46

Summary of Analysis Based on 1983 Export Volume

	Market/Month	Trays Affected: Number	Trays Affected: Proportion of Total in Market or Month	Net Gain: Total	Net Gain: Per Tray
		(No.)	(%)	(NZ$fob)	
1. Intra-Seasonal Price Averaging[a]	(a) Australia (Jan.-April)	11218	10	43921	3.92
	(b) USA (Jan.-Feb.)	182	8	98	0.54
2. Inter-Market Price Averaging[b]	(a) January (Aust.-USA)	3251	13	9074	2.79
	(b) February (Aust.-USA)	3331	6	4453	1.34
3. Transport Cost Reductions[c]	Jan.-March	119902	100	73248	0.61
4. Additional Exports Due to:					
Higher Late-Season Export Packout[d]	March	3547	10[f]	18835	5.31
Higher FOB Returns[e]	Jan.-March	106352	86[f]	257778	2.42

[a] see Table 25
[b] see Table 27
[c] see Table 28
[d] see Table 29
[e] see Table 30
[f] Percentage increase.

actual market conditions holding during the 1983 seasons, and the assumptions made to complete the analysis. The volume of nectarines it would be profitable to divert between different markets and both the direction and profitability of these diversions in subsequent seasons will depend on the prices holding in particular markets in those seasons.

3. Transport Cost reductions i.e. if a CA transport technology could be developed, savings arising from the use of sea rather than air transport could be made. Early season fruit would still be airfreighted to arrive in time to attract premium prices, but the mid and late season fruit could be seafreighted. In total, it was calculated that over $73,000 f.o.b. in freight costs could have been saved through utilising sea rather than air transport after January during the 1983 season. The savings are equivalent to NZ$0.61 f.o.b. per tray exported. Excluding exports to Australia, which only save NZ$0.50 f.o.b. per tray if shipped, the average transport saving was NZ$2.22 f.o.b. per tray. The maximum freight saving of NZ$11.15 f.o.b. per tray could have been captured if nectarines were able to be seafreighted to Europe.

4. Additional exports i.e. the effect of CA storage technology on the volume of exports. Whereas the first three impacts of extended storage were related to the actual volume of exports in 1983, the existence of an extended storage technology would probably have led to a higher export volume. The higher export volume would arise because of two factors. Firstly, since product availability for export limits export volume during March and April rather than market returns, if the estimated average export packout in February of 8.0 per cent was increased to 8.5 per cent, and the additional fruit stored for export in March, then export supplies available in March would have increased by 10 per cent. The results summary in Table 46 shows that the net revenue gain (after the domestic market revenue loss is accounted for) from the additional 3547 trays exported was calculated at NZ$18,835 f.o.b., or NZ$5.31 f.o.b. per tray.

The second factor which suggests a higher volume of exports would have eventuated during the 1983 season is the higher f.o.b. export value returned from seafreighted product. Given the sensitivity of individual markets to higher volumes supplied, it was calculated that an additional 106,352 trays of nectarines could have been exported before f.o.b. values returned to the levels associated with airfreight. After account is taken of the revenue lost from the alternative domestic market, a net gain of NZ$257,778 f.o.b., or NZ$2.42 per additional tray exported, was calculated. The $2.42 per tray can be interpreted as the maximum premium exporters could have paid either as higher transport costs associated with CA sea transport, or in order to attract export fruit from domestic growers.

3.6.3 Summary of Analysis Based on Forecasted 1990 Export Volume

It was estimated that production in 1990 would be 12,810 tonnes, a 112 per cent rise on the 1983 level. Given the greater export orientation of current nectarine plantings, available export volume was calculated to increase by over 400 per cent. In the light of this increase in export availability, and the lack of significant spare freight capacity on existing international passenger flights leaving New Zealand, it was considered unlikely that all available export production would actually be exported. Even assuming an additional 40 per cent airfreight space increment was available in 1990 would result in only 30 per cent of available exports leaving the country. Thus the domestic market would have to absorb the surplus. This scenario was utilised to formulate a base analysis with which subsequent analyses examining the impact of CA storage and transport could be compared. Two major analyses were undertaken, differing as to whether the CA technology was restricted to static (land based) coolstores or whether the technology could be incorporated in shipping containers.

From Table 47 it can be seen that a land based CA storage technology would allow in total an additional 155,500 trays to be exported by sea to the United States, Australia and the Pacific Islands, producing a net revenue gain of NZ$553,330 f.o.b., or NZ$3.56 f.o.b. per additional tray exported. This latter figure indicates the ability to pay for any additional seafreight charges arising out of the introduction and use of the new technology.

TABLE 47

Summary of Analysis Based on Forecasted Export Volume for 1990

	Trays Affected	Revenue Changes[a]			Net Revenue Per Tray Affected
		Domestic	Export	Net	
	(trays)	(NZ$fob)			(NZ$fob/tray)
1. CA Storage and Seafreight to Markets with Transit Time up to 12 Days[b]	155500	-662906	1216236	553330	3.56
2. Intra-Seasonal Price Averaging on Domestic Market (Feb-March)[c]	76297	156768	-	156768	2.05
3. CA Storage and Seafreight to all Markets[d]	301204	-1312436	3564857	2252421	7.48

[a] Change from base analysis assuming 1990 crop marketed according to 1983 market distribution, except for the presence of an upper limit on the number of trays airfreighted. See Table 33.

[b] See Table 38.

[c] See Table 39.

[d] See Tables 43-45.

On the domestic market, a land based technology offers potential for increasing the average revenue per tray sold domestically. In Table 47, it can be seen that when over 76,000 trays were assumed to be stored in February and sold in March, a net revenue gain of NZ$2.05 per tray stored was generated.

If the technology implented allowed nectarines to be seafreighted to all markets, so that the remaining export surplus was marketed in Europe, Asia and the Middle-East, then it was calculated that the net revenue gain would equal NZ$2,252,421 f.o.b. On a per tray basis, the gain is equivalent to NZ$7.48 f.o.b. per tray, providing a considerable margin to cover the expected higher costs associated with the CA shipping technology.

3.6.4 Conclusions

It is apparent from the results presented in Tables 46 and 47 that the introduction of CA technology into the nectarine marketing system is likely to increase returns significantly. In the future, with substantially higher volumes of fruit becoming available for export, the introduction of a technology that allows nectarines to be seafreighted to all markets will be critical in determining the actual volume of nectarines exported.

While the results in Table 46 reveal that CA storage will allow higher volumes of fruit to attract end of season premiums (intra-seasonal price averaging), and allow the differing sensitivity of export markets to quantity fluctuations to be exploited (inter-market price averaging), the volumes of fruit involved in such practices is small compared to the volumes associated with the development of sea transport under CA conditions (see Table 46, 4. Additional Exports). This conclusion is supported by the results reported in Table 47 summarising the analysis based on the forecasted export volume for 1990. The presence of a sea transport option increases export volume by over 230 per cent from that possible without the option of using sea transport.

In terms of the ability to absorb expected higher storage and transport costs associated with CA technology, the data in Tables 46 and 47 show that the net revenue gains from utilising the CA technology would average out at over $2.50 per additional tray exported in 1983 and over $5.50 per additional tray exported for the analysis undertaken for 1990. Thus, it is apparent that significant increases in seafreight costs could be absorbed without making the introduction of CA technology unprofitable.

CHAPTER 4

DOMESTIC APPLE SALES AND

CONTROLLED ATMOSPHERE STORAGE

4.1 Introduction

In Chapter 2 it was concluded that the ability to store and transport apples in a controlled atmosphere (CA) environment for sale in export markets was presently of little advantage to New Zealand. This was due largely to the fact that New Zealand's export season already overlapped with domestic apple harvests in importing countries. Even on export markets where domestic production was an unimportant factor, competition from alternative Southern Hemisphere suppliers determined the profitability of New Zealand's exports rather than the period over which New Zealand exports could be marketed. It was, however, recognised in Chapter 2 that if fruit sold during the existing export season were stored and transported under CA conditions, then the fruit marketed would be of comparatively better quality than fruit held under conventional conditions. Nevertheless the ability to capture these quality improvements in terms of higher prices is not automatic, and depends on the overall competitive position of New Zealand supplies on the market.

Chapter 2 concluded that more immediate and certain gains from CA technology could be obtained on the domestic market for fresh apples. Fresh apple sales are spread over a twelve month period from a harvest that is largely concluded after five months. Hence, fruit quality in later months (i.e. near to the start of the next season) is markedly lower than fruit sold during the current season or immediately after it.

The remainder of this Chapter provides a quantification of the potential impact of CA storage on the domestic market for fresh apples. Section 4.2 presents an analysis of the present market environment. In Section 4.3 estimates of the likely returns to increasing CA storage for the domestic market are provided.

4.2 The Domestic Market for Fresh Apples

4.2.1 Importance of the Domestic Market

In 1981, domestic sales of fresh apples grown in New Zealand totalled 3,485,400 carton equivalents (c.e.), about 65,000 tonnes. Table 48 shows that in terms of total production, the fresh domestic market consumed 27 per cent of all apples marketed. It is clear from Table 48 that domestic fresh apple consumption since 1970 has increased much slower than production so that its importance as a market for the total apple crop has diminished considerably. By comparison, the role of processing as an outlet for the apple crop has doubled in importance since 1970.

TABLE 48

New Zealand Apple Production and Disposal[a]

Year	Volume			Percentages		
	Fresh Export Sales	Fresh Domestic Sales	Processing	Fresh Export Sales	Fresh Domestic Sales	Processing
		(000 ce)			(%)	
1955	1028.1	1876.8	161.6	34	61	5
1965	2257.3	2240.0	566.7	45	44	11
1970	3313.0	2858.6	1199.7	45	39	16
1975	4263.2	3334.8	1650.0	46	36	18
1976	4400.0	3110.2	1532.1	49	34	17
1977	3582.2	2889.4	1294.5	46	37	17
1978	4581.0	2992.6	2398.8	46	30	24
1979	4387.9	3109.9	2145.9	45	32	23
1980	5132.0	3319.4	2827.4	46	29	25
1981	5308.1	3485.4	4187.4	41	27	32

[a] excludes imports.

Source: NZAPMP (various) Annual Reports.
ASD (various) Annual Crop Statistics.
Rae et al (1976). An Economic Study of the New Zealand Pip Fruit Industry. Market Research Centre, Massey University, p226.

4.2.2 Domestic Market Structure

(a) Retail Sales

A feature of the domestic fresh apple market is its clearly defined market structure. The New Zealand Apple and Pear Marketing Board (NZAPMB), in addition to being by statute the sole exporter of fresh apples, is also the monopoly supplier to the domestic retail market. Because of this monopoly, the NZAPMB has a number of constraints applied to it. For the consumer, it aims to supply a common standard of fruit over a ten-month period, to all areas in New Zealand, and at a 'realistic' and stable price. On behalf of the apple grower, the Board must accept all fruit submitted to it that reaches the minimum grading standard, at a price which gives the grower a 'fair' return.

The NZAPMB largely undertakes its domestic marketing responsibilities by controlling both the volume and price at which apples are available to retailers. The volume of sales is controlled by utilising cool-stores which, by the end of May, contain sufficient fruit to supply the market for the rest of the year. At the end of the year, volumes of domestic fruit are supplemented with imports from North American growers (also at the discretion of the NZAPMB).

Retail prices are controlled by the Board through the issue of price lists throughout the year detailing wholesale prices at which particular varieties and grades of apples may be purchased by retailers. Thus, all retailers are guaranteed access to product at the nominated prices. Retailers may then add a transport charge (45 cents per carton) and a markup of up to 40 per cent to arrive at a retail price.

Some fruit stored by the NZAPMB is sold through the auction system. Usually apples enter the auction system from August onwards, when premiums for better quality fruit are highest.

(b) Direct Sales

Although the NZAPMB has a statutory monopoly on retail sales of apples, the monopoly does not provide the high degree of control over total apple sales that might be expected. Specifically, direct selling of apples at the orchard gate to consumers provides an alternative marketing channel for growers. The fact that apple production is widely distributed throughout New Zealand ensures that most consumers are able to take advantage of these gate-sale opportunities.

4.2.3 Trends in Retail and Direct Sales

Table 49 summarises data reflecting domestic apple consumption in New Zealand. The Table reports processed as well as fresh consumption, so that account is taken of the wider apple market.

Fresh apple consumption has risen from 1,876,800 c.e. in 1955 to 3,586,200 c.e. in 1981, a 91 per cent rise. Over the same period, per capita consumption increased by only 28 per cent, to 20.9 kg per capita in 1981. Thus, much of the increase in total consumption has been due solely to population growth.

TABLE 49

Domestic Apple Consumption

1. Fresh

Year	NZAPMB Sales Local Fruit	NZAPMB Sales Imports	NZAPMB Sales Total	Direct Sales	Total Sales	Popn	Consumption per capita	Market Share APMB Sales	Market Share Direct Sales
	(000 ce)			(000 ce)		(000)	(kg)	(%)	(%)
1955	1443.0		1443.0	433.8	1876.8	2130.9	16.3	77	23
1965	1534.9		1534.9	705.1	2240.0	2628.9	15.8	69	31
1970	1548.3	43.2	1591.5	1310.3	2901.8	2816.0	19.1	55	45
1975	1521.6	29.8	1551.4	1813.2	3364.6	3089.0	20.2	46	54
1976	1251.0	46.0	1297.0	1859.2	3156.2	3124.5	18.7	41	59
1977	1011.9	49.1	1061.0	1877.5	2938.5	3140.4	17.3	36	64
1978	1351.6	81.4	1433.0	1614.0	3074.0	3145.9	18.1	47	53
1979	1367.0	110.0	1477.0	1742.9	3219.9	3158.2	18.9	46	54
1980	1534.6	118.4	1653.0	1784.8	3437.8	3161.3	20.1	48	52
1981	1817.2	100.8	1918.0	1668.2	3586.2	3170.9	20.9	53	47
1982	1587.0	153.0	1740.0			3190.1			
1983		238.6							

2. Processed

Year	APMB Processing Production	APMB Processing Exports	APMB Processing Domestic	Direct Sales	Total Domestic Sales	Consumption per capita	Market Share APMB Sales	Market Share Direct Sales
		(000 ce)		(000 ce)		(kg)	(%)	(%)
1977	1031.0	231.0	800.0	263.5	1063.5	6.3	75	25
1978	1882.0	982.0	900.0	516.8	1416.8	8.3	63	37
1979	1744.0	544.0	1200.0	401.9	1601.9	9.4	75	25
1980	2436.0	400.0	2036.0	391.4	2427.4	14.2	84	16
1981	3669.0	1500.0	2169.0	518.4	2687.4	15.7	81	19
1982	3322.0	1086.0	2236.0					

3. Fresh and Processed

Year	Volume Fresh	Volume Processed	Volume Total	Market Share Fresh	Market Share Processed
		(kg/capita)		(%)	
1977	17.3	6.3	23.6	73	27
1978	18.1	8.3	26.4	69	31
1979	18.9	9.4	28.4	67	33
1980	20.1	14.2	34.3	59	41
1981	20.9	15.7	36.6	57	43
1982					

Source: NZAPMB Annual Reports, Wellington.
ASD Annual Crop Statistics, MAF, Wellington.
Rae et al. (1976, p.226)
NZDS Export Statistics, Government Printer, Wellington.

Up until 1977, the Board's share of the fresh apple market declined continuously, reaching a low of 36 per cent in 1977. In other words, by 1977 almost two-thirds of all fresh apple sales were being made at orchard gate from roadside stalls. The 1977 season was an exceptional year, with total production being at the lowest level since 1973. In 1978 and 1979, the downward trend in the Board's share of the fresh apple market was arrested, and in subsequent seasons has been reversed. By the 1981 season, the NZAPMB had gained a 53 per cent share of the fresh apple market.

A major reason for the reversal of the downward trend in the Board's market share was the policy (begun in 1979) of introducing the nominated price-list selling system for early-season fruit, rather than sending the fruit to auction. In previous years the volume of early-season fruit delivered to the Board by growers ensured high auction prices. This reinforced both the incentive for orchardists to sell direct to the public at prices reflecting the absence of distribution costs and retail markups, and the incentive for consumers to buy from the gate-seller. Since 1979, the Board has used the nominated price system to offer low priced product to retailers, allowing the retailer to compete more successfully with the gate-seller. The success of this policy was reported in the NZAPMB's 1980 Annual Report, which noted that Board sales during the January to May period were 58 per cent higher than the corresponding time in 1978. One factor enabling the Board to sell greater volumes early in the season has been its ability to import fruit from North America to supplement late season sales. Table 49 shows that in 1983, imports totalled 238,600 c.e., enough to supply the domestic market for over one month.

Table 49 also details trends in domestic consumption of processed apple products (mainly apple-juice). In the four year period 1977-1981, per capita consumption of processed apples grew 150 per cent from 6.3 to 15.7 kg per capita with the NZAPMB having an over 80 per cent share of the processed apple market in 1981. It is significant to note that processed apple consumption now accounts for over 40 per cent of total domestic apple sales volume. The recent growth in processed apple consumption is therefore likely to have been an important factor in holding per capita fresh apple consumption at a relatively static level since 1970.

4.2.4 Regional Fresh Apple Production for the Domestic Market

A significant factor influencing the NZAPMB's marketing decisions is the requirement that they supply all regions in New Zealand. Direct-selling is a major influence on the profitability of the Board's regional operations.

Table 50 presents MAF estimates of local fresh production for the 1980 season. In the North Island, only the growers in the Poverty Bay and Hawkes Bay provinces submit a higher proportion of fruit to the Board than they sell at the gate. The Hawkes Bay fruit is especially important to the Board, since it is this fruit that is used to fulfill the NZAPMB's commitment to retailers in regions with low submissions in relation to consumer demand. The Board must therefore incur additional distribution costs to transport fruit to these regions. The Board's policy of maintaining a common price throughout the country means that retail prices in regions distant from Hawkes Bay do not reflect the full cost of transporting the fruit to the region. Obviously, this improves to some extent the competitive position of retail fruit in relation to gate-sold fruit available from local producers. Conversely, in regions of excess supply, the Board's competitive position is impaired by the common-price policy.

In the South Island, Canterbury is the only province where growers sell more at the gate than they submit to the Board.

TABLE 50

Regional Fresh Apple Production for the Domestic Market 1980 Season

Region	Volume NZAPMB Receipts	Volume Direct Selling	Percentages NZAPMB Receipts	Percentages Direct Selling
	(tonnes)		(%)	
Northland	-	130	-	100
Auckland	3191	11790	21	79
Waikato	1413	3500	29	71
Bay of Plenty	-	2050	-	100
Poverty Bay	555	350	61	39
Hawkes Bay	17615	3860	82	18
Wairarapa	821	1290	39	61
West Coast N.I.	-	2200	-	100
North Island	23595	25170	48	52
Nelson	11280	1050	91	52
Marlborough	1022	390	72	28
Canterbury	2532	3860	40	60
Otago	6225	2552	71	29
South Island	21059	7852	73	27
New Zealand	44654	33022	57	43

Source: ASD (1980) Annual Crop Statistics, MAF Wellington.

4.2.5 Seasonal Distribution of Fresh Apple Sales

The NZAPMB is committed to supplying the retail market with fresh apples for at least a ten-month period. Thus, the storage of fruit for sale in later months of the year is an important function of the NZAPMB. Gate-sellers, being under no compulsion to ensure year-round apple supplies, utilise storage facilities to a much lesser extent.

Given information regarding the varietal composition of fresh fruit sold domestically by gate-sellers and the NZAPMB (and hence the harvest spread of domestic supplies), and the seasonal selling patterns of these market participants, the seasonal distribution of fresh apple production, sales and stocks can be approximated.

Figure 3 shows that NZAPMB sales peak over the March to May main harvest period, co-inciding with the height of direct selling. This reflects graphically the Board's policy, begun in 1979, of adopting a more aggressive competitive position in relation to gate sellers. The seasonal distribution of Board sales portrayed in Figure 3 is in marked contrast to the distribution of sales prior to 1979. In earlier years, sales during the harvest period were lower than the sales volume in subsequent months when the July to October period saw peak sales volumes being made. In Section 4.2.3 it was noted that the NZAPMB's 1980 Annual Report mentioned that sales during the January to May period were 58 per cent higher than the corresponding time in 1978. Given that total Board sales grew 15 per cent over the 1978-80 period, and the fact that under the old sales distribution January to May sales accounted for a third of total sales, sales in 1980 from June onward must have actually been lower than the corresponding period in 1978. Thus, the policy introduced by the Board in 1979 has had a marked influence on the seasonal availability of fresh apples.

The Board's policy of more aggressive competition with gate sellers has also necessitated a change in the Board's price policy. The nominated price-lists for retailers during the early months of the season are set at their seasonally lowest levels. Later in the season, the Board compensates for these low price levels through increasing prices faced by retailers. Of course, this action sacrifices to some degree the aim of ensuring stable consumer prices throughout the season. Nevertheless, even if the Board did set a constant price for the entire season, consumers themselves would, to the extent that they bought from gate sellers, still experience seasonal price fluctuations.

Figure 3 also reveals the seasonal stockholding position of the NZAPMB. By the end of May stocks peak, so that from then onwards, domestic sales are made from stored produce. Early season varieties such as Cox's Orange, Kidd's Orange, and Gala are not stored for long periods, but are sold before the main harvest varieties are released. Supplies of the early season varieties are usually exhausted by mid-April, allowing releases of Red Delicious, Golden Delicious and Jonathon to be increased. Because of this policy, most of the fruit still in store by the end of May originates from harvests during April and May. Given the conventional storage life of apples, this enables the quality of apples released onto the domestic market to be maintained at least until August. After August, fruit quality will begin to diminish if all ruit is conventionally stored. It is significant that since the 1978 season, the NZAPMB has been involved in selling fruit stored in controlled atmosphere (CA) stores. CA stored fruit has been sold during November and December in competition with Red Delicious apples imported from North America. During the 1978 season, CA apple storage began with the commissioning of a 100,000 c.e. store in Hastings. The 1978 season saw a further CA store being opened in Auckland, again with a capacity of 100,000 c.e. This latter store is not solely intended to supply the local market since significant quantities of the stored fruit have been exported to the Pacific Islands in some years. Taken together, the NZAPMB's CA stores provide enough capacity for the equivalent of one month's normal apple sales.

4.2.6 Marketing Costs and Returns

In Table 51, indicative marketing costs and returns associated with Board sales and direct selling are summarised for the 1982 season. Direct sellers, being able to avoid many of the marketing and distribution costs incurred by the NZAPMB, is able to under-sell apples sold at retail by at least 35 per cent. The savings the NZAPMB is able to make through bulk selling in applecrates and bins as compared to traditional traycarton packing is also indicated by the data presented in Table 51.

FIGURE 3

Estimated Seasonal Distribution of Fresh Apple Sales 1981 Season

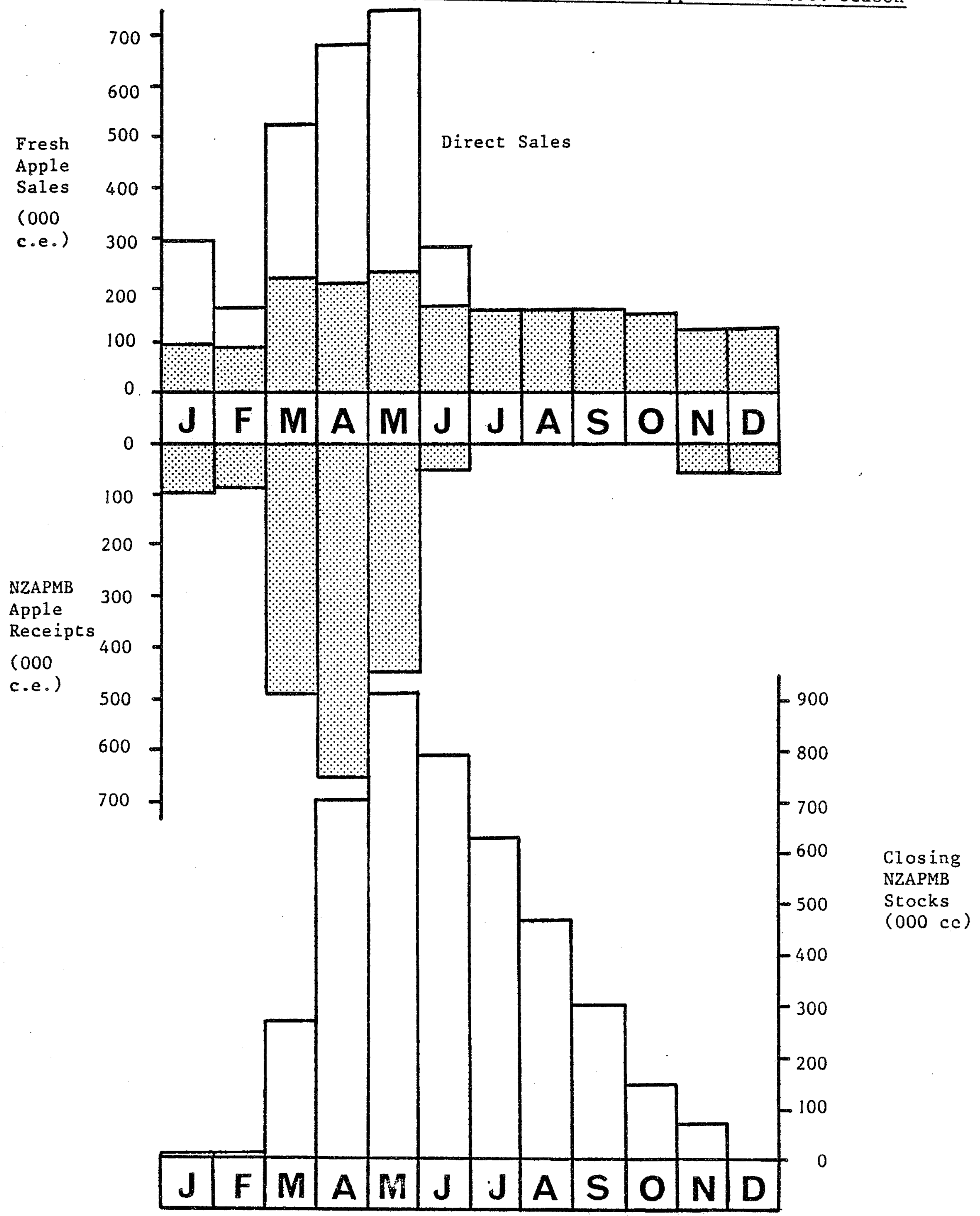


TABLE 51

Indicative 1982 Marketing Costs and Returns:
Comparison of Retail and Direct Selling

	Fruit Submitted Loose to NZAPMB for Domestic Market		Direct Sale
	Packed in Traycarton	Applecrate or Bulkbin	
	($ per carton equivalent)		
Payment to Grower			
Fruit Value	3.50	3.50	6.30
Thru Shed Cost[a]	0.17	0.17	1.70
Proximity to Market	0.10	0.10	
Other[b]			1.00
Total	3.77	3.77	9.00
Marketing Costs			
Carton	1.40		
Pack Materials	1.22		
Packing Thru Shed Costs	1.42		
Freight	2.50		
Marketing and Administration	2.69		
Total	9.23	6.23	
Cost of Fruit to NZAPMB	13.00	10.00	
Cost of Fruit to Consumer	18.83	14.59	9.00

[a] Interest, depreciation and labour in packing shed.

[b] Costs incurred in operating gate sale operation.

4.2.7 Benefits and Costs of Controlled Atmosphere Storage

(a) Net Revenue Gain Per Carton

Apples stored in controlled atmospheres and sold after August command a premium at the retail level of between 20 and 30 per cent over conventionally stored apples. The additional value of CA fruit is of course partially offset by the additional capital and operating costs for a CA store. In Table 52 it is calculated that on a carton-equivalent basis a CA coolstore with a capacity of over 100,000 cartons (representative of a CA store operated by the NZAPMB) would require additional capital repayments of $0.47 cents per carton equivalent. Operating costs for the CA store are likely to be about $0.60 per carton equivalent higher than a conventional cool-store. In order to represent the additional costs faced by a gate-seller in developing CA storage capacity, the capital costs for a small (10,000 carton equivalent capacity) CA store have also been calculated, and reported in Table 52 Rae et al. (1976; Table 1.21) report that in Canterbury and Auckland, the average apple and pear orchard produced 8,500 and 7,500 carton-equivalents of fruit respectively. Thus a CA coolstore with a 10,000 carton capacity would provide adequate long-term coolstorage for four or five growers, depending on the proportion of the crop stored. Larger scale orchards orientated toward the domestic market could probably justify a small CA store for their own production. The orchard size CA store is reported in Table 52 to cost an additional $0.61 annual capital expenditure per carton of coolstore capacity, 25 per cent higher than a conventional store.

TABLE 52

Additional Annual Capital Cost for Controlled Atmosphere Coolstores

	Store 1 (small)		Store 2 (large)	
	Conventional Traycarton Store	Controlled Atmosphere Bulk Store	Conventional Traycarton Store	Controlled Atmosphere Bulk Store
Capacity (traycarton equivalents)[a]	10350	12420	103440	124140
Capital Cost (plant and buildings)[a]	$186500	$279750	$1445000	$2167500
Annual Capital Repayment[b]	$24969	$37453	$193457	$290185
Annual Capital Repayment per traycarton equivalent	$2.41	$3.02	$1.87	$2.34
Additional Annual Capital Repayment for Controlled Atmosphere Store	$0.61		$0.47	

[a] From NZKLA (1982) capital costs for 60,000 and 600,000 tray coolstores respectively, increased by 50 per cent for controlled atmosphere store. Coolstore capacity for controlled atmosphere store is increased by 20 per cent.

[b] Table mortgage for 20 years at 12 per cent.

Table 53 reports a comparison of the marketing costs and returns from retail and direct selling of CA stored apples. Direct sellers were assumed to undersell retailers by 30 per cent. In developing the costs and returns reported in Table 53 it was considered reasonable to only charge the additional capital and operating costs associated with a CA store for retail sales, but the total capital and operating costs associated with a CA store for direct sales. This approach can be justified since the costs reported in Table 51 exclude any significant coolstore and storage costs for direct sales, but retail sale costs include costs incurred from NZAPMB coolstore operations. Put another way, it is assumed that for the gate seller, the decision is one of whether or not to store fruit, whereas for the NZAPMB the decision is whether to store conventionally or in CA conditions.

For retail apple sales, CA stored fruit sold in applecrates is priced at $17.50 per carton equivalent, 20 per cent higher than for the conventionally stored fruit reported in Table 51 equivalent to an increase of $2.91 in monetary terms. The majority of this increased revenue is retained by the NZAPMB through higher margins applied on fruit delivered to retailers, since retail mark-ups were held constant. After account is taken of the $1.07 additional costs associated with the CA coolstore, the Board's net gain per carton is estimated at $1.01.

Assuming that gate sellers continue to substantially undercut retail level prices for CA stored fruit, prices at the gate would increase by over 36 per cent to $12.25 per carton equivalent, but still be 30 per cent lower than the retail price level. After account is taken of the additional costs associated with the construction and operation of a CA store, the net revenue gain at the gate was estimated to be $3.25 per carton. However, in terms of the fruit value received by gate sellers, revenue per carton fell by $0.97. For gate sellers already storing apples in conventional coolstores for sale in the latter half of the year, the costs of developing CA capacity could be much lower than those assumed in Table 53. For example, CA conditions may be established within their existing coolstore using the flexible 'tent' method at greatly reduced cost. Fruit value in such cases would be much higher than that estimated for gate sellers in Table 53.

The loss in fruit value reported in Table 53 could be almost eliminated if gate sellers undersold retailers by only 25 per cent instead of 30 per cent. A net gain in fruit value is calculated if a discount of only 20 per cent between retail and gate selling is applied.

4.3 Conclusions

It is clear from the preceding analysis that the net revenue gains per carton from the CA storage of apples are likely to be positive for both the NZAPMB and gate sellers. It was calculated that the NZAPMB gained an additional $1.01 per carton CA stored, and gate sellers $0.78 per carton stored, so long as the gate sellers only undersold the retailers by 20 per cent.

The NZAPMB's commissioning in recent years of two 100,000 carton equivalent CA coolstores, storing fruit predominantly for the domestic market, bears testimony to the profitability of CA storage in their operations. It is significant that the development of CA storage to provide for apple sales late in the year has co-incided with the policy of selling greater volumes of fruit during the first half of the year, when gate sales are at a peak. Thus, the Board has consciously undertaken to sell greater volumes of fruit in the first half of the year, and lesser but high quality volumes of fruit in the latter half of the year. Shortfalls in supplies of high quality domestically grown fruit for sale late in the year are being filled by importing North American fruit. This policy is also closely tied to the NZAPMB's export strategy, since reciprocal trade has increasingly become a requirement for the maintenance of market access for New Zealand apples on export markets.

TABLE 53

Net Revenue Gain from Sales of Controlled Atmosphere Stored Apples

		($ per carton equivalent)	
1. NZAPMB Applecrate			
Payment to Growers[a]		3.77	
Marketing Costs			
Conventional[a]	6.23		
Additional Costs			
- Capital[b]	0.47		
- Operating	0.60	7.30	
Cost of Fruit to NZAPMB		11.07	
Cost of Fruit to Consumer		17.50	
Net Revenue Gain at Retail[c]		2.91	
Net Revenue Gain to NZAPMB[d]		2.08	
NZAPMB Revenue Gain Net of Additional Costs		1.01	
2. Direct Selling		Discount from Retail 30%	20%
		($ per carton equivalent)	
Cost of Fruit to Consumer		12.25	14.00
Marketing Costs			
Thru Shed Cost[a]	1.70		
Additional Costs			
- Capital[b]	3.02		
- Operating	1.20		
Other	1.00	6.92	6.92
Fruit Value		5.33	7.08
Net Revenue Gain at Gate[c]		3.25	5.00
Net Revenue Gain on Fruit[e]		-0.97	0.78

[a] From Table 51

[b] From Table 52

[c] Difference between cost of fruit to consumer in this table and Table 51.

[d] Calculated from Tables 51 and this table, after assumptions regarding NZAPMB and retail margins made.

[e] Difference between fruit value in this table and Table 51.

Given the NZAPMB's more aggressive approach to competing with gate sellers, its current CA storage capability, and the growth in apple imports from North America, it is unlikely that much requirement is seen for additional CA capacity for the domestic market. The already high per capita consumption of fresh apples in New Zealand is another important reason for reaching this conclusion.

From the analysis undertaken in this Chapter it is probable that gate sellers have more incentive to develop additional CA storage facilities than the Board. In the face of a more price competitive market during the traditional gate selling season, it seems reasonable to assume that incentive exists for gate sellers to extend their selling season. While probably not increasing overall sales significantly, this strategy would at least enable them to maintain their share of the fresh apple market, and increase their income at the same time. Growers in Auckland, Waikato and Canterbury have the greatest opportunity to take advantage of the benefits from CA stores, since they are close to large population centres, and distant from the NZAPMB's main supplying regions of Hawkes Bay and Nelson.

CHAPTER 5

KIWIFRUIT PACKING OPERATIONS AND CONTROLLED ATMOSPHERE STORAGE

5.1 Introduction

In Chapter 2, the implications of controlled atmosphere (CA) storage for kiwifruit export marketing were discussed. Given the storage life of kiwifruit under conventional coolstorage, it was apparent that all potential markets could be exploited utilising lower cost sea transportation. Also, the storage life of kiwifruit did not appear to restrict exporters from attaining their desired seasonal distribution of exports. The desired seasonal export distribution for kiwifruit has two peak selling periods. The first occurs during May and June, before domestic summer fruit supply in the Northern Hemisphere increases. The second peak occurs during September. New Zealand grown kiwifruit sold after September increasingly face competition from the Northern Hemisphere kiwifruit crop, so that the commercial advantage of extended kiwifruit storage life to New Zealand exporters is unlikely to be great.

It was concluded in Chapter 2 that CA storage is likely to have its greatest impact on the period over which kiwifruit may be packed prior to export or long-term coolstorage. Currently, nearly all kiwifruit are graded and packed within one week of harvest. Thus, the grading and packing operation must be largely completed within the six week harvest period. It is technically quite simple to extend the packing season to sixteen weeks utilising a carbon dioxide/air CA. As an over 600 per cent increase in kiwifruit production is expected between 1983 and 1990 the ability to extend the packing season will become important. If the six week period for grading and packing operations was maintained, considerable investment in appropriate grading and packing facilities would be required if the whole crop was to be handled. Any extension of the packing season could reduce the required investment considerably.

The economic analysis presented below compares three feasible storage technologies that allow the packing season to be extended. The first two incorporate CA conditions in the coolstore, either by building a rigid CA coolstore, or by introducing flexible plastic 'tents' into conventional coolstores. Both of these technologies allow the packing season to be extended by ten weeks.

The third storage technology evaluated excludes the necessity of creating CA conditions. In Chapter 2 it was established that high-humidity conditions were a by-product of creating a CA environment. High-humidity by itself has been found responsible for generating the majority of the period by which CA conditions extend the packing season. Specifically, in a high-humidity coolstore, the packing season could be extended by an additional four weeks, allowing a ten week packing period.

Section 5.2 presents a number of economic parameters that differ between technologies. In Section 5.3 the current grading, packing and storage system is described, as is the increase in kiwifruit production to 1990. Based on these increases in production, and assuming a six week harvest and packing season is maintained, total required investment in packhouses and coolstorage is estimated. Using these estimates as a base, the results of an evaluation of the three alternative technologies are presented in Section 5.4. Conclusions from the analysis are summarised in Section 5.5.

5.2 Utilisation and Capital Costs of Coolstores under Alternative Technologies

In seeking to extend the packing season through CA or high-humidity coolstores, account must be taken of the effects these technologies have on both the utilisation of coolstores and the coolstore's construction costs. Using a conventional coolstore storing tray-packed fruit as a base, Table 54 summarises three important parameters which are basic to the evaluation that is undertaken in the later sections. It is clear from the data presented in Table 54 that the identification of the most cost-efficient option is not clear-cut, since trade-offs exist for each technology between the parameters. For example, although a flexible tent CA store increases capital costs by only ten per cent compared to a 50 per cent increase if a rigid CA store is built, the rigid CA coolstore allows coolstore utilisation to improve by 20 per cent in comparison to the conventional coolstore, whereas the flexible tent technology is associated with a decline in utilisation, in spite of bulk storage.

TABLE 54

Parameters of Alternative Coolstore Technologies

Technology	Coolstore Utilisation	Capital Cost	Associated Length of Packing Season
	(% change from conventional coolstore storing tray-packed fruit)		
1. Rigid CA Bulk Store	+20	+50	+167
2. Flexible Tent CA Bulk Store	-10	+10	+167
3. Rigid High-humidity Bulk Store	+20	+20	+ 67

In order to translate the percentages in Table 54 into actual volume and dollar terms, information contained in the New Zealand Kiwifruit Authority's publication detailing packhouse and coolstore costs has been utilised (see NZKA; 1983) generating the data presented in Table 55. It is significant that although the additional capital costs of utilising the flexible tent CA technology are low, when utilisation changes are accounted for, the technology's capital cost per tray-equivalent is almost as high as the rigid CA technology. The per tray-equivalent capital cost for the rigid CA is $2.80, a 25 per cent increase compared to the conventional coolstore.

The rigid high-humidity bulk coolstore has an estimated capital cost per tray-equivalent of $2.24, identical to a conventional coolstore and 20 per cent lower than the rigid CA store. However, given that the high-humidity coolstore is associated with a shorter packing season, it is not necessarily the most cost-efficient option. Section 5.4 evaluates the additional factors that must be accounted for in determining the most cost-efficient option, namely, packhouse capital costs, labour costs, bulk-bin capital costs, and parameters associated with packhouse and coolstore throughput.

TABLE 55

Coolstore Utilisation and Capital Costs
Under Alternative Technologies

Technology	Coolstore Capacity	Capital Cost[a]	Capital Cost per Tray
	(tray-equivalents)	($)	($/tray)
1. Conventional coolstore	1,000,000	2,240,000	2.24
2. Rigid CA Bulk Store	1,200,000	3,360,000	2.80
3. Flexible Tent CA Bulk Store	900,000	2,464,000	2.74
4. Rigid High-humidity Bulk Store	1,200,000	2,688,000	2.24

[a] Buildings and plant only, land costs excluded.

Source: NZKA (1982)

5.3 Packhouse and Coolstore Requirements for Six Week Packing Season

5.3.1 Introduction

The discussion in this Section is aimed at describing the grading, packing and storage facilities available to the kiwifruit industry during the 1982 season, and estimating the facilities required by 1990 assuming the six week packing season is retained. In Section 5.4, these estimates are used as the base on which comparisons with the technologies which extend the packing season are made.

5.3.2 Facilities Available During the 1982 Season

The NZKA (1982) reported that during the 1982 season, packhouse and coolstore design capacities were 16.449 million trays and 7.064 million trays respectively. Due to adverse climatic conditions during harvest, the kiwifruit export crop only reached 4.67 million trays during the season, hence, considerable excess capacity existed in the industry during the 1982 season. It is apparent from the data presented in Table 56 that the presence of excess capacity will only be a short-term phenomenon. By 1990, export production of kiwifruit is projected to increase to 71.74 million trays, assuming medium yields and an 80 per cent export packout. Given the 1982 packhouse capacity of

16.449 million trays, this capacity will be exceeded in 1985. Similarly, based on a coolstore design capacity of 7.064 million trays in 1982, the data in Table 56 reveal that projected production in 1983 will exceed this capacity. It should be noted, however, that coolstore capacity in practice does not have to equate to the level of available export production. This would only be the case if the export season began only after the harvest had been completed. It has been noted in Section 5.1 that the harvest period (May and June) actually coincides with one of the two peak exporting periods. In 1982, the NZKEA's Annual Report provides statistics showing that 37 per cent of all exports were undertaken during the May/June period. It can be concluded that since exports are undertaken during the harvest season, a one-to-one ratio between packhouse and coolstore facilities is unnecessary.

TABLE 56

Projected Trend in Kiwifruit Production Available for Export

Season	Export Availability Based on Medium Yields and Export Packouts of:		
	75%	80%	85%
	(millions of trays)		
1983	9.19	9.77	10.33
1984	13.22	14.07	14.88
1985	19.48	20.73	21.98
1986	27.36	29.10	30.90
1987	37.17	39.61	42.04
1988	47.92	51.08	54.24
1989	58.26	62.08	65.94
1990	67.30	71.74	76.19

Source: MAF (1982)

Based on the actual packhouse and coolstore capacities available during 1982, a ratio of 2.33 for packhouse: coolstore capacity can be calculated, which can be defined as the coolstore throughput factor. Given that a proportion of both the packhouse and coolstore capacities in 1982 would have been established in anticipation of the growth in future production, it is probably better to calculate the coolstore throughput factor based on the seasonal distribution of exports. Since 37 per cent of production was exported by the end of June, 63 per cent of the total export harvest in 1982 would still have been in store at that time. This indicates a coolstore throughput factor of about 1.6 (i.e. 100/63).

5.3.3 Facilities Required for the 1990 Season

It is assumed throughout the remaining discussion that kiwifruit export production will total 71.74 million trays in 1990. That is, medium yields and an 80 per cent export packout are assumed. It is also assumed that packhouses and coolstores will have design capacities of one million tray equivalents. This latter assumption is clearly unrealistic, since it implies all packhouse and coolstore developments will follow the off-orchard co-operative type, exemplified by the Bay of Plenty Fruitpackers Ltd and Cold Storage (BOP) Ltd's complex at Te Puke. However, assuming a mix of packhouse/coolstore scales of operations would only introduce an unnecessary complication to the discussion without altering the conclusions derived from the analysis.

In Table 57 the additional packhouse and coolstore requirements for the 1990 season are reported, estimated at 55.29 million tray-equivalents and 37.78 million tray-equivalents respectively.

TABLE 57

Additional Packhouse and Coolstore Facilities
Required for the 1990 Season - Six Week Packing Season

	1982	1990	Additional Requirements
		(millions of trays)	
Packhouse Capacity	16.45	71.74	55.29
Coolstore Capacity[a]	7.06	44.84	37.78

[a] 1990 coolstore capacity estimated assuming throughput factor of 1.6.

These requirements were then converted into the additional financial investment in packhouses and coolstores that would have to be made. The results of this analysis are presented in Table 58. The results show that just under $183 million must be invested in packhouse and coolstore facilities over the period 1983 to 1990 in order to retain a six week packing season. Coolstore facilities make up 47 per cent of this cost, and packhouse buildings and plant 43 per cent. The remaining 10 per cent of the investment is divided between labour and bulk-bin expenses. While labour is strictly an operating cost rather than a capital cost, it is included in Table 58 to indicate the labour force required for the packing operation. Over 11,000 additional workers will be required if a six week packing season is retained. In a recent study of the supply and demand for seasonal labour in the Bay of Plenty it was concluded that by 1984, significant numbers of workers would have to be found from outside the region (NZKA; 1983). Hence, labour force implications must be recognised in any evaluation of extending the kiwifruit packing season. Any reduction in the required labour force will also reduce expenditure on the provision of transport, accommodation, and public utilities.

TABLE 58

Additional Costs of Providing Packhouse and Coolstore Facilities for the 1990 Season - Six Week Packing Season

	Number	Unit Cost	Total Cost	Per cent of Total Cost
	(No.)	(1982$)	(1982$)	(%)
Packhouses				
- Buildings and Plant[a]	56	$1,387,000	$ 77,672,000	43
- Labour[b]	11200	$5/hr	$ 13,440,000	7
- Bulk-bins[c]	212654	$30/bin	$ 6,379,620	3
Coolstores[a]	38	$2,240,000	$ 85,120,000	47
Total Additional Cost			$182,611,620	100

[a] as per NZKA (1982), assuming design capacities of one-million trays.

[b] 200 workers per packhouse (100 workers per eight-lane grader), working 8 hour days over a 30 day season.

[c] bulk-bins required to transport 55.29 million trays of additional fruit from orchard to packhouse. Assume 65 trays per bin, and each bin used four times in the season.

5.4 Packhouse and Coolstore Requirements with an Extended Packing Season

5.4.1 Introduction

In Section 5.3 the packhouse and coolstore requirements in 1990 assuming a six week packing season were estimated. It was estimated that just under $183 million had to be invested between 1983 and 1990. Using this estimate as a base, the additional investment required assuming the packing season is extended is now calculated and compared to the base estimate. As was discussed in Section 5.1 three bulk storage technologies will be evaluated. The coolstore utilisation and capital cost parameters for these technologies, reported in Section 5.2, will be utilised for the analysis.

5.4.2 Analysis of Packing Season Extension Options

(a) Introduction

The analysis undertaken to evaluate the number and cost of additional packhouses and coolstores required by 1990 assuming an extended packing season is summarised in Tables 59 and 60.

TABLE 59

Additional Packhouse and Coolstore Facilities Required for the 1990 Season - Extended Packing Season

	Rigid CA Bulk Store		Flexible Tent CA Bulk Store		High-humidity Bulk Store	
	During Harvest (6 weeks)	Post-Harvest (10 weeks)	During Harvest (6 weeks)	Post-Harvest (10 weeks)	During Harvest (6 weeks)	Post-Harvest (4 weeks)
1. Production 1990 (m.trays)	71.74	nil	71.74	nil	71.74	nil
2. Packhouses						
2.1 Capacity 1982 (m.trays)	16.45	27.42[a]	16.45	27.42[a]	16.45	10.97[b]
2.2 Required Capacity 1990 (m.trays):	26.90	44.84	26.90	44.84	43.04	28.70
2.3 Additional Capacity Required by 1990 (m.trays)	10.45	17.42	10.45	17.42	26.59	17.73
2.4 Additional Packhouses Required (m.tray capacities)	11	nil[c]	11	nil[c]	27	nil[c]
3. Coolstores						
3.1 Capacity 1982 (m.trays)	7.06		7.06		7.06	
3.2 Coolstores Required for Production Packed Outside Harvest Season (m.trays):						
- Conventional Equivalent		44.84		44.84		28.70
- Specialised Equivalent[d]		37.37		49.82		23.92
- Number Specialised Coolstores (m.tray capacities)		38		50		24
3.3 Coolstores Required for Production Packed Inside Harvest Season (m.trays):						
- Production Packed During Harvest Season	26.90		26.90		43.04	
- Coolstore Throughout Factor	3.84		3.84		2.62	
- Total Coolstore Capacity Required	7.01		7.01		16.43	
- Additional Coolstore Capacity Required	-		-		9.37	
Coolstores (m.tray capacities)	nil		nil		10	

[a] 1982 capacity utilised over 10 weeks rather than 6 weeks.
[b] 1982 capacity utilised over 4 weeks rather than 6 weeks.
[c] Additional packhouses utilised during harvest season are more than sufficient to meet additional post-season packhouse requirements.
[d] Found by dividing conventional equivalent by coolstore utilisation factor associated with technology.

(b) Additional Packhouse and Coolstore Facilities Required

In Table 59 it can be seen that for both CA associated technologies, an additional 10.45 million trays of packhouse capacity is required after the packing season is increased from six to sixteen weeks. By comparison, if the packing season's length is held at six weeks, an additional 55.29 million trays of packhouse capacity is required (see Table 57). Given the increase in packhouse capacity under the CA technologies, less than 40 per cent of the projected 1990 harvest is packed during the harvest period, the remaining 44.84 million trays being bulk stored for packing after the harvest is completed.

The high-humidity coolstore technology allows 40 per cent of the harvest to be packed outside the harvest season, requiring an additional 26.59 million trays of packhouse capacity, bringing total packhouse capacity under the technology up to 43.04 million trays. Since only 28.70 million trays would be packed after the harvest season, considerable excess capacity would exist during the final four weeks of the packing season.

Given the volumes of fruit calculated as being packed after the harvest period, additional coolstore facilities would then have to be built in which the fruit could be bulk-stored until the harvest was completed. For example, it is calculated that 44.84 million trays of fruit would have to be stored for packing after the harvest season under the rigid CA coolstore technology option. Since the fruit would be bin-stored, coolstore utilisation would increase (in this case by 20 per cent, see Table 54, Section 5.2), so that the total capacity of coolstores built for holding the 44.84 million tray-equivalents need only be 37.37 million tray-equivalents. Of course, after the harvest season when packing began, the fruit held in bulk storage would pack-out to 44.84 million trays, exceeding the 37.37 million tray storage capacity. However, it is reasonable to assume that following packing, significant quantities of fruit would be exported immediately, so that additional storage facilities would be unnecessary. In the case of the flexible tent CA technology, the fact that bulk storage actually reduces coolstore utilisation (because of the tent structures) means that after the fruit is packed, the storage space required to hold the packed fruit is less than required for the bulk-stored fruit.

For the fruit packed inside the six week harvest season, additional conventional coolstore capacity would have to be built above the 1982 season's capacity of 7.06 million trays. It is assumed that the seasonal kiwifruit export distribution in 1990 will be similar to that undertaken in 1982. Given the market conditions facing kiwifruit exports (such as the summer fruit peak production in July, and the growth in competitive Northern Hemisphere kiwifruit production), it seems likely that this is a reasonable assumption. Thus, of the 71.74 million trays projected to be available in 1990, 37 per cent or 26.54 million trays would have to be exported by the end of June. Clearly, if up to half of the fruit harvested is stored for packing after the harvest season, a much higher proportion of fruit packed during the harvest season will have to be exported. This has important implications for the conventional coolstore capacity required to store fruit packed during the harvest period. If 37 per cent of total exports are exported before the end of June, coolstore throughput factors will have to be much higher for the stores holding packed fruit. It is estimated that these throughput factors would have to be over 3.8 in the case of both CA coolstore technologies, and just over 2.6 for the high-humidity technology (see Table 59). Given these throughput factors, and present conventional coolstore capacity, it is projected that an additional ten conventional million tray capacity coolstores would have to be built if the high-humidity bulk storage option was adopted. No further coolstores would be needed for the CA technology options.

TABLE 60

Additional Costs of Providing Packhouse and Coolstore Facilities for the 1990 Season - Extended Packing Season

Packing Period (weeks)	Rigid CA Bulk Store 16	Flexible Tent CA Bulk Store 16	High-humidity Bulk Store 10
1. Additional Facilities Required (No.)			
Packhouses			
- Buildings and Plant	11	11	27
- Labour	2,200	2,200	5,400[a]
- Bulk-bins - for bulk storage	689,846	689,846	441,538
- for harvesting	40,192	40,192	102,269
- Total	730,038	730,038	543,807
Coolstores			
Specialised	38	50	24
Conventional	nil	nil	10
2. Total Cost (1982$)[b]			
Packhouses			
- Buildings and Plant	$15,257,000	$15,257,000	$37,449,000
- Labour	13,440,000	13,440,000	13,440,000
- Bulkbins	21,901,140	21,901,140	16,314,210
Coolstores			
Specialised	127,680,000	123,200,000	64,512,000
Conventional	nil	nil	22,400,000
Total Additional Cost	$178,278,140	$173,798,140	$154,115,210
3. Percentage of Total Cost (%)			
Packhouses[c]			
- Buildings and Plant	9	9	24
- Labour	8	8	9
- Bulkbins	12	13	11
Coolstores			
Specialised	72	71	42
Conventional	nil	nil	15

[a] peak additional labour demand for six weeks, only require 3,600 workers for the additional four weeks.

[b] unit costs taken from Tables 55 and 58.

[c] percentages may not add up to 100 due to rounding.

(c) Labour and Bulk-Bin Costs

Following on from the projected additional packhouse and coolstore requirements presented in Table 59, the costs associated with providing these requirements are summarised in Table 60. Apart from the building and plant requirements for the additional packhouses and coolstores, it can be seen from Table 60 that labour and bulk-bin costs are also estimated. Labour costs are identical to those reported in Table 58 for the six week packing season. While labour costs are identical whether a six, ten or sixteen week packing season is assumed, the actual number of workers required for the packing operation are not. The figures in Table 60 reveal that a sixteen week packing season potentially available under both CA technologies, would reduce additional labour requirements from 11200 to 2200. The ten week packing season associated with the high-humidity technology option, would have a peak additional labour requirement of 5400 workers for six weeks, and 3600 workers for four weeks. Given the likely scarcity in 1990 of casual labour to meet the 11,200 worker labour requirements of a six week packing season, these labour savings in themselves add support to any measures taken to extend the packing season.

The analysis presented in Table 58, assuming a six week packing season, estimated that an additional 212654 bulk-bins would be required by 1990 for harvesting and orchard-to-packhouse transport of kiwifruit. Since the storage technologies which extend the packing season are based on bulk storage of kiwifruit, additional bins would have to be acquired. This requirement arises because as the kiwifruit are put into bulk store, the bulk bin holding them cannot be re-used until the fruit are packed out. For example, given the 44.84 million trays bulk stored under the CA storage technologies, over 730,000 additional bulk-bins would be required. To cope with the additional 10.45 million trays packed within the harvest season, a further 40,000 bulk bins are required, assuming each bin is circulated four times during the season.

(d) Total Cost of Additional Facilities

Estimates of the total additional costs of providing packhouse and coolstore facilities under the three bulk storage technologies are reported in Table 60. Total cost estimates ranged from $154.1 million for the high-humidity bulk-store option, to $178.3 million for the option including rigid CA bulk stores. The total cost associated with the flexible-tent CA bulk store option was only slightly lower than the rigid CA option, amounting to $173.8 million. All of these cost estimates are lower than the $182.6 million estimate made assuming a six week packing season in 1990.

In percentage terms, packhouse buildings and plant expenditure makes up only 9 per cent of total expenditure for each CA technology reported in Table 60. By comparison, the data in Table 58 summarising the costs associated with a six week packing season show that packhouse buildings and plant contribute over 40 per cent of total expenditure. Conversely, the cost of coolstores which made up 47 per cent of additional total expenditure with a six-week packing season, is seen in Table 60 to account for up to 72 per cent of total expenditure under an extended packing season. Thus, the extension of the packing season produces a relatively more coolstorage intensive and less packhouse capital intensive industry.

(e) Optimal Usage of Controlled Atmosphere Technology

The analysis undertaken has assumed so far that the technical ability to utilise CA technology to extend the packing season to sixteen weeks was appropriated fully. The results of the analysis show that complete adoption of the sixteen week CA technologies reduces costs associated with a six week packing season by two to five per cent, but overall are 13 to 16 per cent more expensive than the high humidity technology. In itself, this result cannot be taken as indicating the economic superiority of the high humidity technology over the CA technologies. Before any conclusions may be made, sensitivity analysis of the CA technologies must be undertaken by varying the length of time the packing season is extended via controlled atmospheres. A shorter packing season would reduce the number of higher cost specialised CA coolstores required to store fruit for packing outside the harvest season, and increase the number of relatively cheaper packing sheds required. The number of bulk bins would also be reduced with a shorter overall packing season.

Table 61 reports an analysis which identifies the economic effects of reducing the length of time the packing season is extended by CA technology, thus reducing the number of relatively high cost CA coolstores required. The lowest overall cost of extending the packing season is $165.6 million, the cost associated with a four week extension. In percentage terms, the overall cost of a four week extension to the packing season is seven per cent lower than a ten week extension, and eight per cent lower than the costs associated with a total packing season of only six weeks. Nevertheless, the 10 week rigid CA technology still compares unfavourably with the high humidity bulk store technology (at an incremental cost of $154.1 million).

TABLE 61

Additional Costs of Providing Packhouse and Coolstore Facilities for the 1990 Season - Rigid CA Technology Under Different Packing Season Assumptions

Additional Requirements	Packing Season (weeks)					
	6	8	10	12	14	16
1. Number of:						
(a) Packhouses						
- Buildings and Plant	56	38	27	20	15	11
- Bulkbins - for storage	0	275846	441538	551846	630615	689846
- for harvesting	212654	143692	102269	74692	55000	40192
Total	212654	419538	543807	626538	685615	730038
(b) Coolstores						
Specialised	nil	15	24	32	35	38
Conventional[a]	38	17	8	3	1	nil
2. Total Costs (1982 $million)						
(a) Packhouses						
- Buildings and Plant	77.7	52.7	37.4	27.7	20.8	15.3
- Labour	13.4	13.4	13.4	13.4	13.4	13.4
- Bulkbins	6.4	12.6	16.3	18.8	20.6	21.9
(b) Coolstores						
Specialised	nil	50.4	80.6	107.5	117.6	127.7
Conventional	85.1	38.1	17.9	6.7	2.2	nil
Total Additional Costs	182.6	167.2	165.6	174.1	174.6	178.3

[a] assuming throughput factors of 1.6, 2.3, 3.0, 3.84, 3,84, and 3.84 respectively.

5.5 Conclusion

The objective of the preceding discussion was to evaluate the role CA storage could have in extending the period over which kiwifruit may be packed prior to export or long-term storage. CA conditions prior to storage could be created either in a specially constructed rigid CA store, or within a conventional coolstore incorporating a flexible tent structure. Given these two alternative technologies, and the fact that the packing season could also be extended through the construction of high-humidity coolstores, it became necessary to evaluate the costs associated with each alternative. In each case, estimates were made of the total packhouse and coolstore investment required to cope with the projected kiwifruit export crop in 1990. The investment in packhouses and coolstores required, assuming the packing season continues to be limited to the harvest period, was also estimated.

Based on the analysis presented in this Chapter, it is apparent that the total cost of investment in packing and coolstore facilities that must take place between 1983 and 1990 can be reduced significantly by extending the packing season. Compared to the $182.6m investment required to ensure a six week packing season is maintained, extension of the packing season by 10 weeks (to 16 weeks) utilising rigid CA bulk stores allows savings of $4.3 million to be made. Higher savings ($17 million) could be made by extending the packing season by only four weeks utilising the rigid CA technology.

Although the CA storage technology enables considerable savings in total investment to be made, even greater savings could be made by extending the packing season by four weeks (to 10 weeks) using high-humidity bulk coolstorage. In comparison to the investment associated with a six week packing season, adopting the high-humidity storage option is estimated to reduce total investment costs by almost 16 per cent, or $28.5 million. Thus, while the use of CA storage conditions is technically possible and economically of some advantage, it is an economically inferior option in comparison to the lower cost high-humidity storage technology.

In concluding that the high-humidity storage technology is economically superior to the CA technology, it should be recognised that even more economical options could be developed to cope with projected increases in the kiwifruit crop. For example, it has been assumed throughout this discussion that packhouses operate on a single shift, thirty day season. Clearly, double shifts and weekend work would allow much greater throughput in existing packhouse facilities, and would reduce the amount of additional packhouses required in the future. Of course, the demand for labour associated with this option may limit its introduction. However, by 1990, automatic packing may complement the existing automation of grading, so that the labour constraint may not be as severe.

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